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THE TOOL ENGINEER

OFFICIAL PUBLICATION OF THE ASTE AMERICAN SOCIETY OF TOOL ENGINEERS

A Threat Without End ... by A. M. Sargent
Tooling Fields and Coolants—A Symposium
The Trend of Cutting Fields ... by D. J. Reynolds
What the Tool Engineer Should Know About Cutting Fluids ... by H. B. Osborn
Cutting Speeds and Feeds ... by Frederick W. Taylor
The Selection of Cutting Fluids ... by James Geoghegan
Flexibility in Small-Lot Production Broaching ... by Broaching Engineer
Shape Turning on a Lathe ... by Arnold T. Keck
The Tool Engineer's Place in Industry ... by C. E. J. Bolster
The Rake Clearance and the Point of the Tool ... by George B. Sharp
The Processes and Application of Cast Wear-Resisting ... by H. W. Gillette
"Balanced Production" with a Tool of Today ... by E. R. Schroeder
High Production Automatic Screw Machines ... by Henry J. Burnett
Departments
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AMERICAN SOCIETY OF TOOL ENGINEERS

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TABLE OF CONTENTS

		Page
A Thread Without End	*by A. M. Sargent*	17
Cutting Fluids and Coolants—A Symposium		18
The Testing of Cutting Fluids	*by D. J. Wangelin*	
What the Tool Engineer Should Know About Cutting Fluids	*by W. H. Oldacre*	
Cutting Speeds and Feeds	*by Frederick W. Lucht*	
The Selection of Cutting Fluids	*by Joseph Geschelin*	
Flexibility in Small-Lot Production Broaching	*by The Broaching Institute*	29
Shape Turning on a Lathe	*by Kermit T. Kuck*	33
The Tool Engineer's Place in Industry	*by C. E. J. Brickner*	37
The Human Element and the Point of the Tool	*by George W. Sharp*	39
Mass Spectrometer for Industry	*by Phil Glanzer*	41
The Process and Application of Lost Wax Casting	*by H. W. Giesecke*	42
"Balanced Production" with a Tool of Today	*by A. E. Rylander*	45
High Frequency Induction Brazing Machine	*by Henry J. Burnett*	46
New Press Designed for Fine Perforating	*by Anders Jansson*	48

DEPARTMENTS

A.S.T.E. News	49
Fundamentals of Tool Engineering	61
Andygrams	63
Gadgets	64
Good Reading	65
Bulletins and Trade Literature	66
Tools of Today	67
North, East, West, South in Industry	76
Index to Advertisers	142

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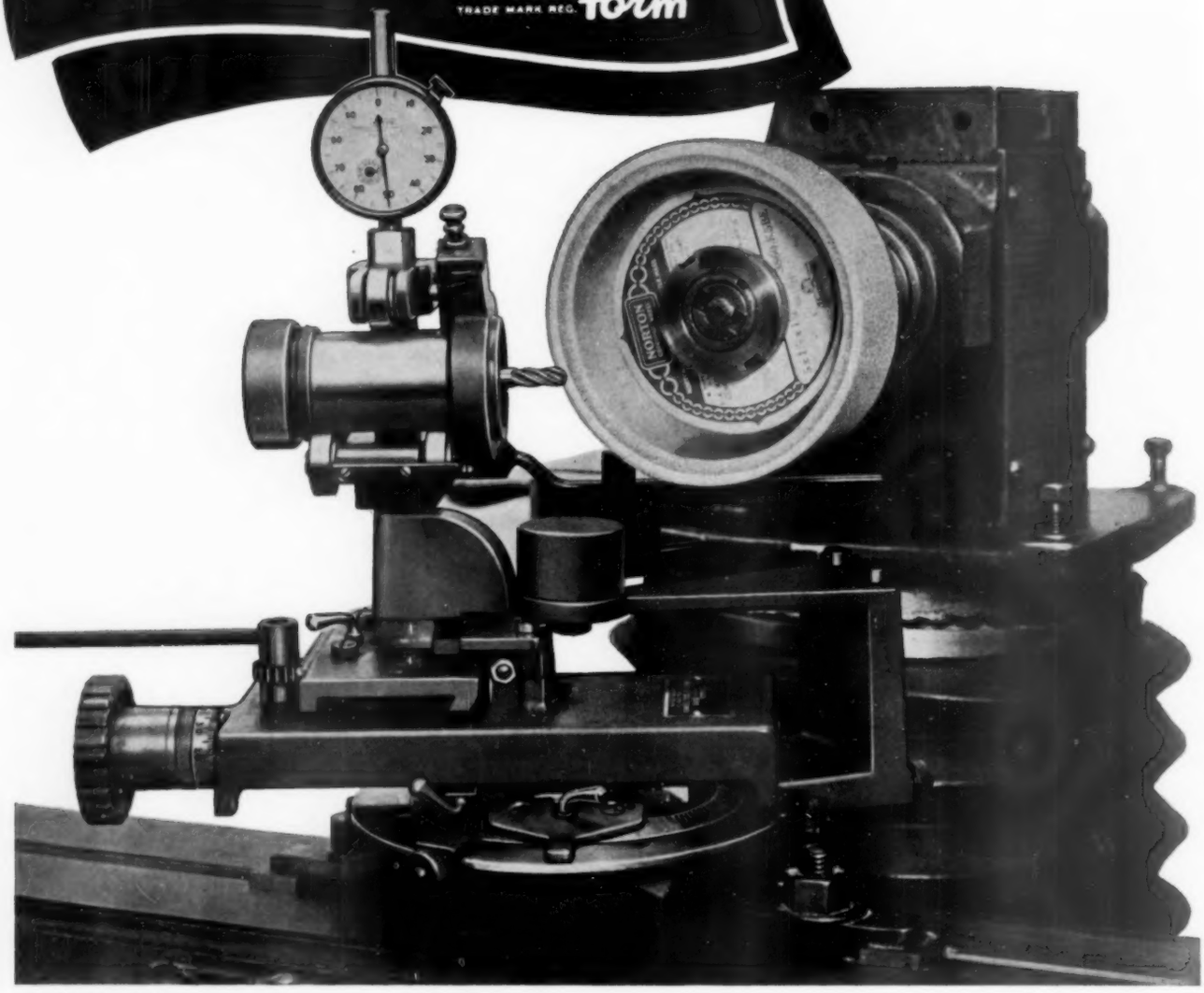

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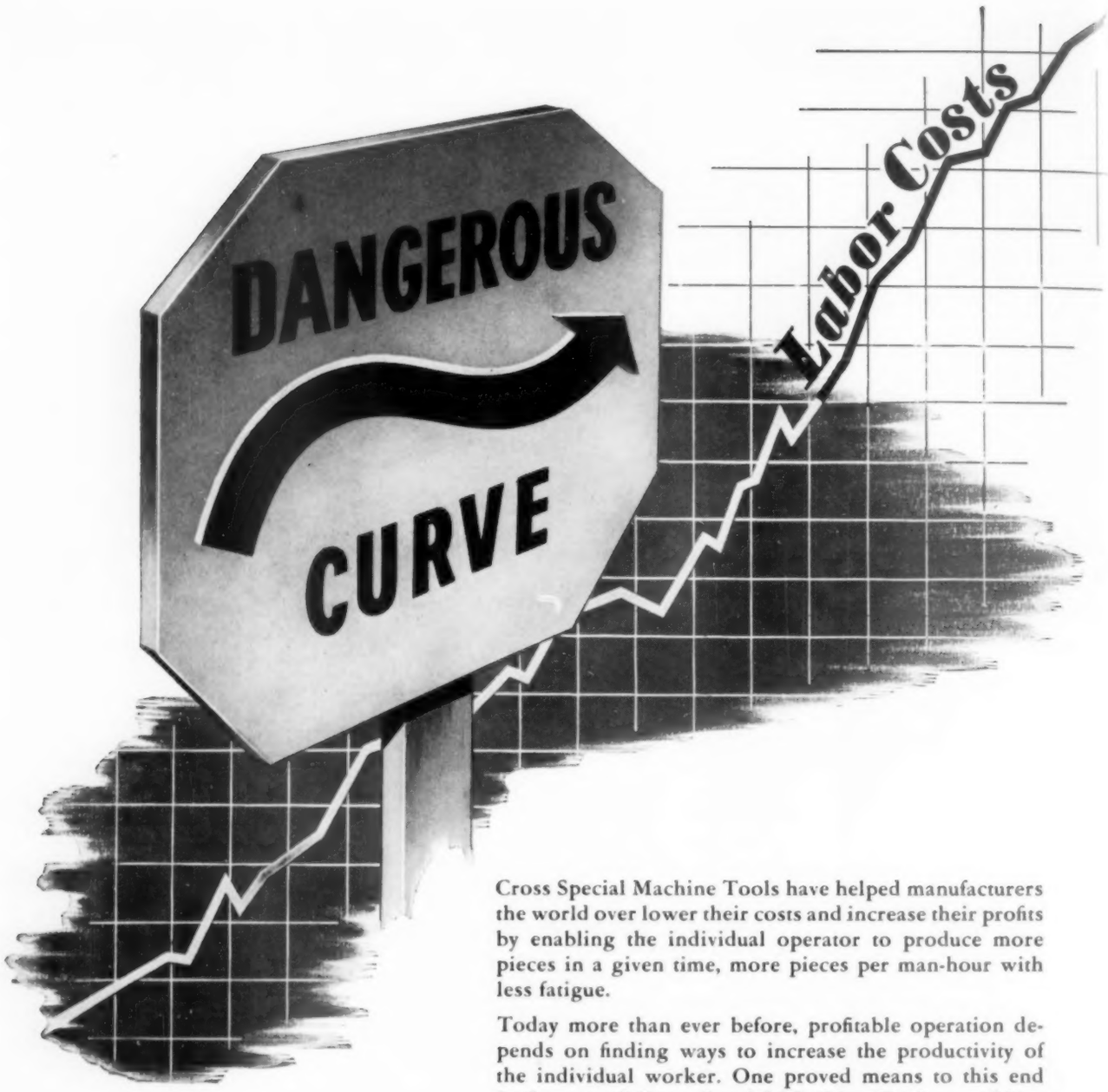

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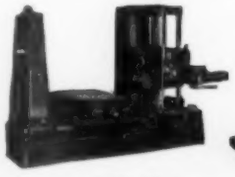
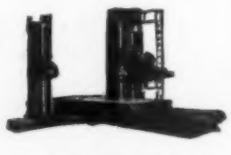


G. & L. Table Type Machine

G. & L. Floor Type Machine



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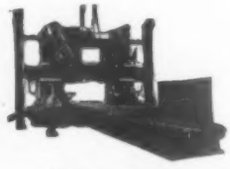

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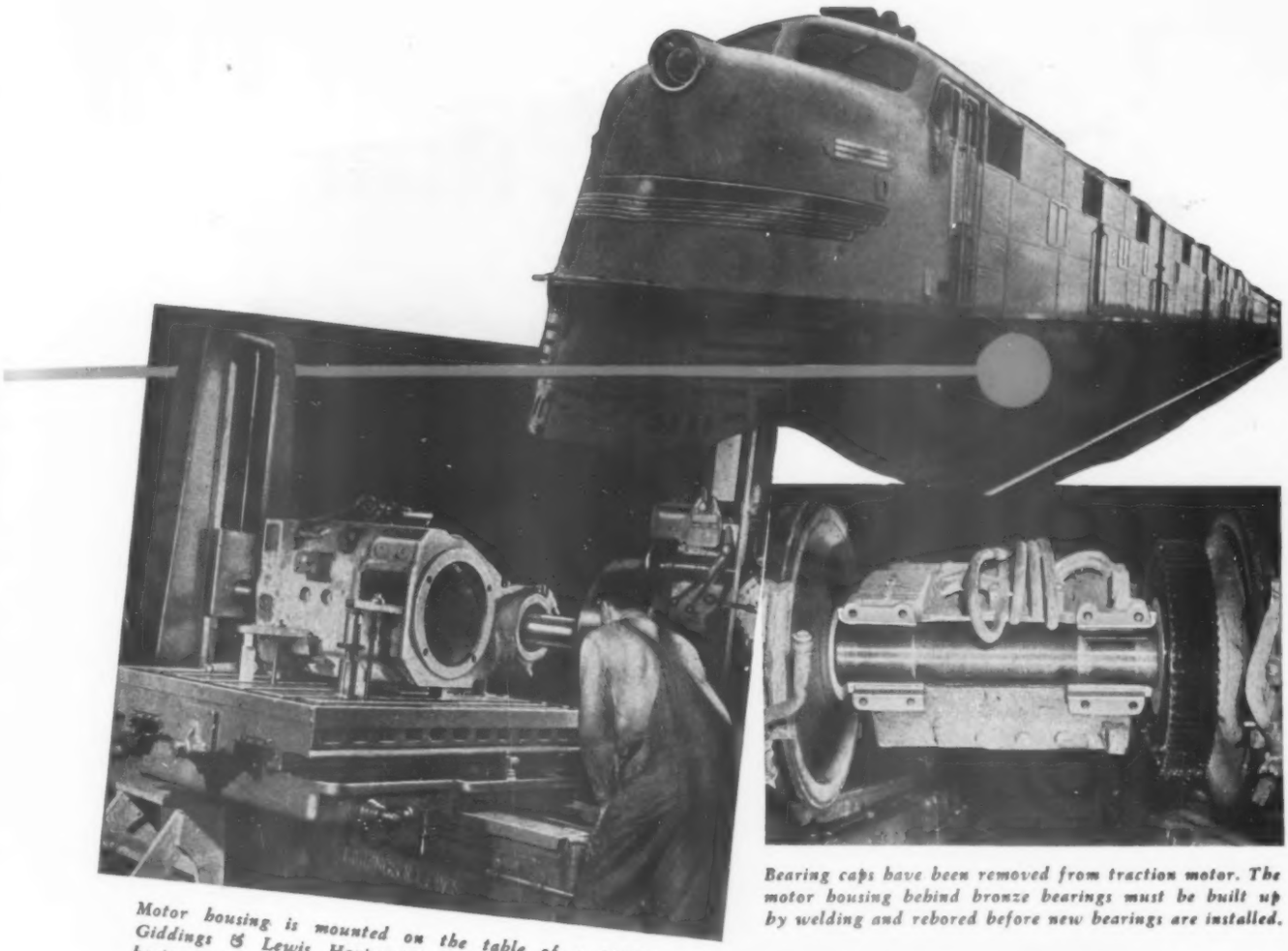
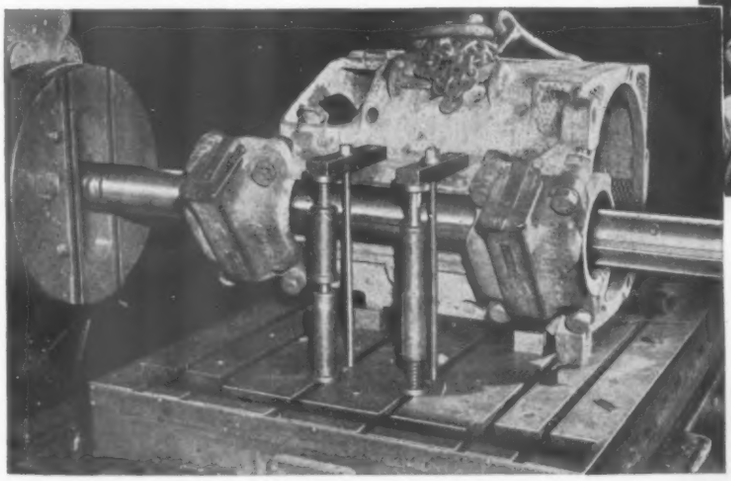
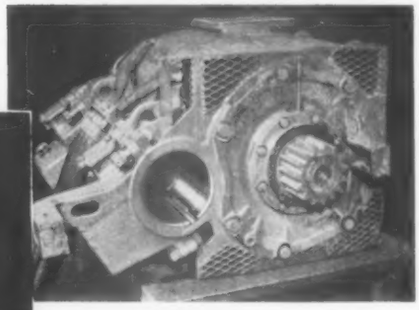


Motor housing is mounted on the table of a 350-T Giddings & Lewis Horizontal Boring Machine. Two boring cuts are made simultaneously.

Bearing caps have been removed from traction motor. The motor housing behind bronze bearings must be built up by welding and rebored before new bearings are installed.



Motor housing in the process of being rebored. Two cutters are used to speed this operation. Full support of boring bar between machine headstock and end support column insures accurate bore alignment.



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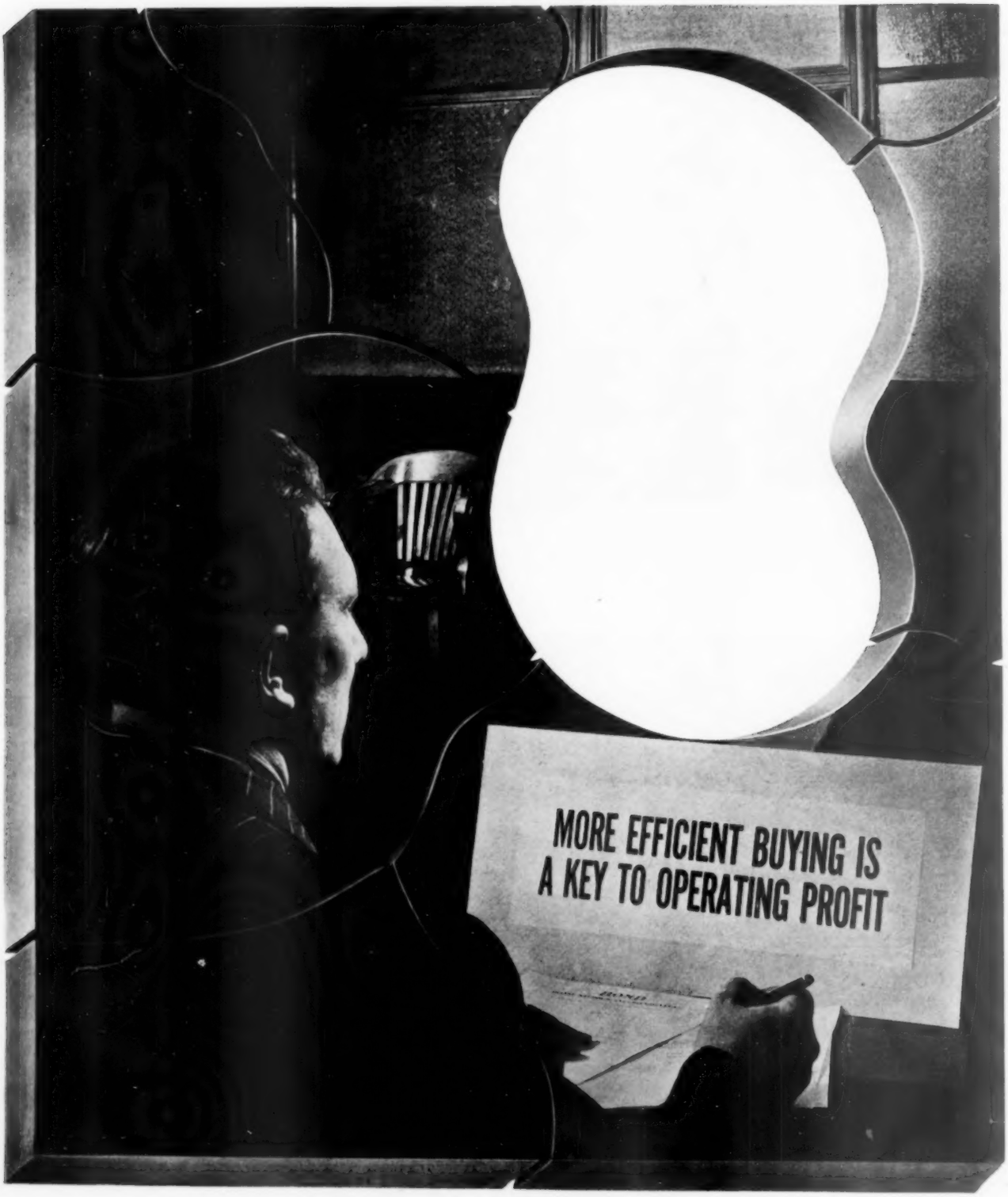

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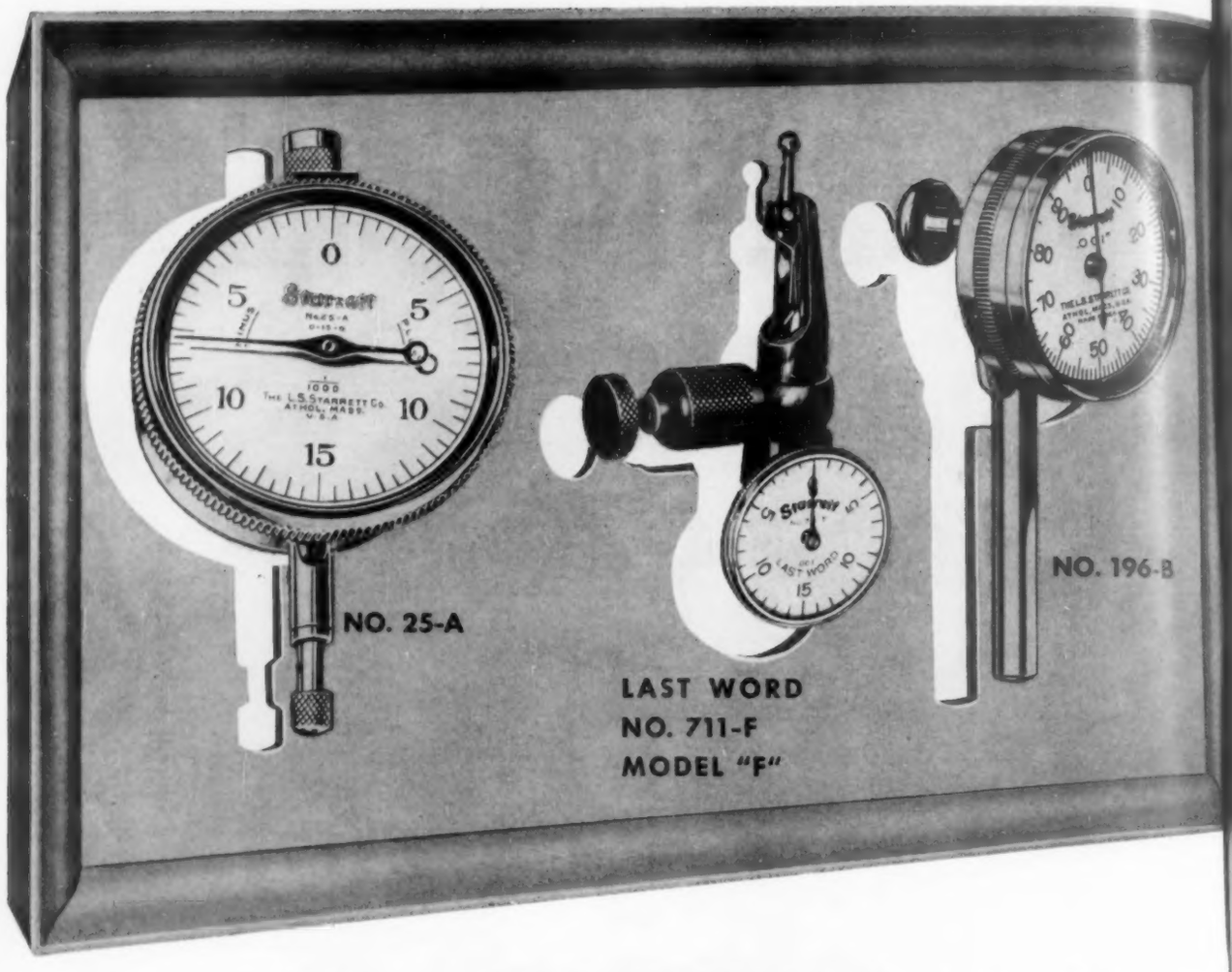

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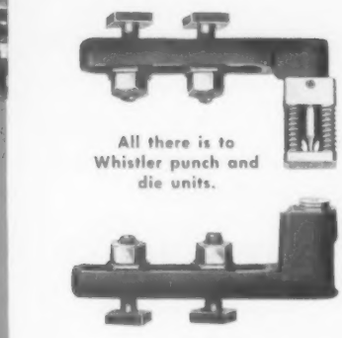

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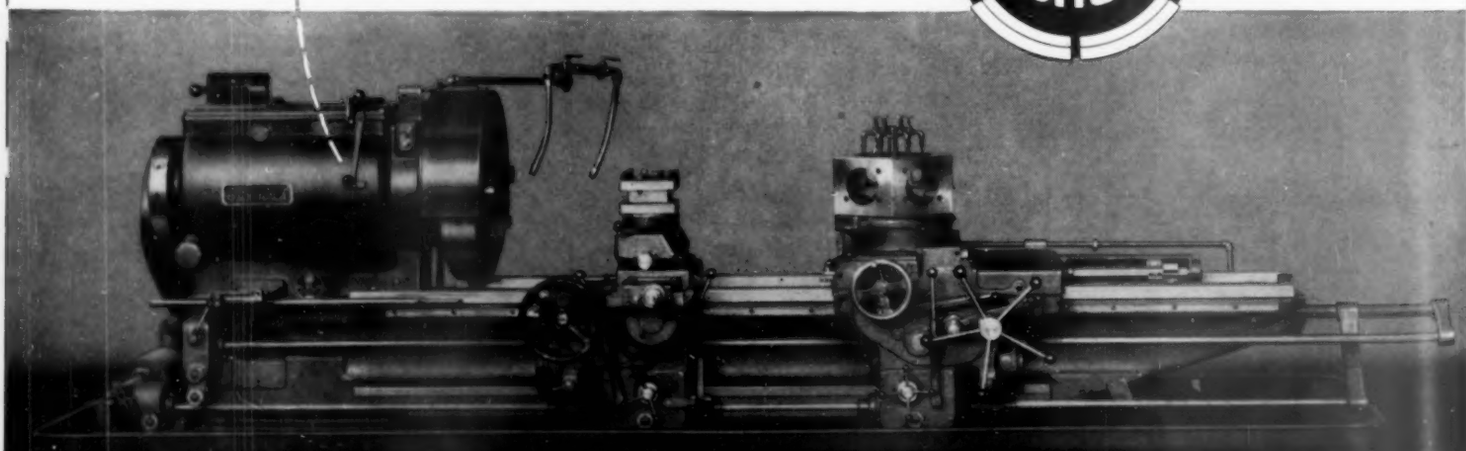

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MANUFACTURERS OF STANDARD AND OF SPECIAL PRODUCTION CUTTING TOOLS

THIS NEW *SUPER* TOOL BIT SAVES MONEY 7 WAYS!

Check These New *Super* Features For Lower Production Costs!

NEW *SUPER* EJECTOR-TYPE TOOL BIT

SUPER EJECTOR TYPE TOOLS
(Complete with 1 Carbide bit)

TOOL ORDER NUMBER		SHANK SIZE	SIZE SOLID CARBIDE INSERT
RIGHT HAND	LEFT HAND		
ER-1	EL-1	3/4x3/4x4 1/2	1/4x1/4x2
ER-2	EL-2	1x1x7	3/8x3/8x2
ER-3	EL-3	1 1/4x1 1/4x8	3/8x3/8x2
ER-4	EL-4	1 1/2x1 1/2x8	3/8x3/8x2
ER-5	EL-5	3/4x1x6	3/8x3/8x2
ER-6	EL-6	1x1 1/4x8	3/8x3/8x2
ER-7	EL-7	1x1 1/2x8	3/8x3/8x2

SOLID CARBIDE BITS for SUPER EJECTOR TYPE TOOLS

TOOL ORDER NUMBER		SIZE
FOR STEEL	FOR IRON, NON-FERROUS MAT., PLASTICS	
ES-1	EG-1	1/4x1/4x2
ES-2	EG-2	3/8x3/8x2

NOTE: Above bits are ground to fit holder, and require only sharpening at cutting end.

1. Bit-Holding Mechanism is inside where it can't interfere with free chip flow or assembly in tool block.
2. The heavy cross section of well supported Carbide insures the successful making of deep cuts and heavy feeds without cracking.
3. Absence of brazing strains due to mechanical holding of tip.
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5. No steel is removed in grinding, insuring rapid and economical reconditioning of the tool.
6. Replaceable Carbide bit is extra long for longer life.
7. Each holder can be used for machining any material. Replaceable Carbide bits are furnished in proper grade for each job.

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Editorial

A Thread Without End

THERE is an important thread that is woven well through the warp and woof of American progress. And, until the loom stops finally, that thread will continue as the strongest fiber in our industrial existence. There can be no stopping, there can be no standing still, for this thread is an unbroken sinew spawned into our fabric by the American pioneer. It pulls and guides us through the endless cavalcade of industrial progress. As long as America is, this thread will be . . . a thread without end.

This sturdy tendon is today leading us into a new era of mass production: higher production speeds . . . greater precision . . . revolutionary, new processes of manufacture . . . new materials . . . and better working conditions.

The pioneering of tool engineers has been largely responsible for these myriad advancements.

But tool engineering, as a recognized profession, is still young enough to win laurels, not merely to wear them. These engineers of mass production must see that industrial innovations, many of them born in the crucible of war, are quickly translated into benefits for all people—everywhere.

Approaching this assignment with characteristic efficiency and thoroughness, these experts of assembly-line techniques will weave into the whole cloth of contemporary life . . . new and more attractive product designs . . . greater efficiency for all commodities . . . entirely new products . . . more and better goods at minimum costs . . . and more work for more people.

The very nature of their work has taught tool engineers that yesterday's success is history. Their reputation and the future of civilization depend on how well they perform tomorrow.

Viewing their work from these angles, tool engineers see a sort of fourth dimension in their activities . . . because these activities transcend the current matters of present-day production, employment of new techniques, and utilization of new machines.

Their activities enter into the realm of time and space. Every corner of the globe feels the fruits of their work. There is hardly a civilized person in the world who does not benefit many times every day from the exacting science, skill and craftsmanship of tool engineers.

Not only are tool engineers guided by this thread without end, but they are spinning the fiber into a mighty rope that is lifting burdens from men's shoulders, lessening their toil, raising their standards of living, and opening the way for greater opportunity.

Theirs is the invigorated, sinewy thread of the pioneer . . . a thread without end.

President 1946-47

A Symposium

Cutting Fluids and Coolants

Cutting Oils and Compounds Extend Tool Life and Enhance Quality

The Testing of Cutting Fluids

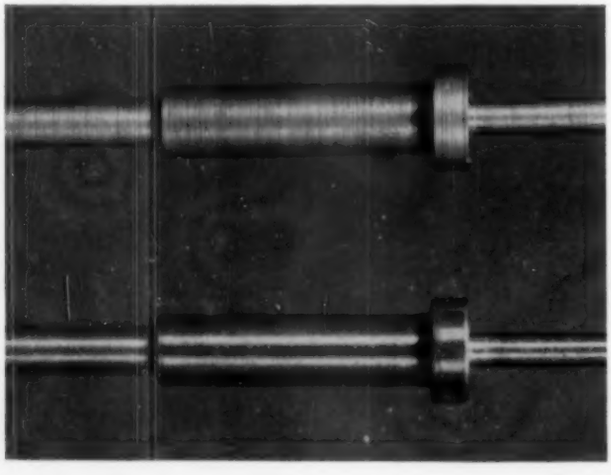
by D. J. Wangelin

Cutting fluids are used primarily to improve a machining operation by increasing the life of the tools used, improving the finish obtained and maintaining greater dimensional accuracy by limiting the temperature fluctuations in the work and the tool. Certain secondary requirements of the cutting fluid must also be kept in mind. It must lubricate chips flowing through restricted chip spaces, such as in deep hole drilling and, frequently, must be able to lubricate parts of the machine tool as well. In automatic screw machines, for instance, the quantity of cutting fluids used is such that much of it gets onto bearing surfaces that must be lubricated and it is essential that this oil lubricate the machine tool in addition to acting in the capacity of a cutting fluid.

In broaching operations, it is also essential that the cutting fluid lubricate the walls of the broach as it passes through the work. It must also lubricate the chips, as they slide across the teeth of the broach, to prevent scoring of the broached surfaces in the work. Usually, it must not stain the work or the machine, and must be capable of being readily removed by common cleaning methods. If the work is going to have further finishing operations, staining may not be important; however, the greater percentage of machining operations probably require a non-corroding type of cutting fluid. This is particularly important if the work is to be plated, painted or otherwise finished.

Cutting fluids are known to improve tool life by cooling and what we commonly call lubrication of the chips flowing across the tool. Whether the mechanism of this lubrication is similar to the mechanism that we think of in speaking of lubrication is a question, so far, not completely answered. It is known, however, that cutting forces are reduced by the use of cutting fluids and that tool life is increased, although the increase is not necessarily proportional to the decrease in cutting forces. Just how cutting fluids improve or increase tool life is not a subject of this paper. It has been discussed many times before and no definite conclusions have been drawn, but most of you are doubtless familiar with the work that has been done along these lines.

Dry and wet cutting—Note superior finish when applying fluid.



D. J. Wangelin **is a graduate of the College of Engineering, University of Michigan, and a member of the Independent Research Committee on Cutting Fluids; also, of the A.S.M.E. Research Committee. Having devoted two years to research and testing of cutting fluids at U. of M., under direction of Prof. O. W. Boston, he joined the Pure Oil Company in 1939, and has since specialized in the testing and application of cutting fluids.**

Another well-known function of cutting fluids is to control the size of the built-up edge on the tool by reducing its size. This improves finish and may eliminate chatter, the latter function being very desirable in getting optimum finishes. Fig. 1 shows one instance in which the elimination of chatter and the control of the built-up edge has greatly improved finish—in fact, the cutting fluid in this case proved to be the difference between an acceptable job and one which was not acceptable.

Before discussing a test procedure for testing cutting fluids, it might be well to ask: "Why test a cutting fluid in the first place?" You buy a cutting fluid from a reliable producer, expect it to do the work and may feel that there is no need on your part to do any testing. However, there are dozens of different types of cutting fluids, some designed for specific applications. The most are general in nature, but very many of your jobs require a rather special type of cutting fluid.

Unfortunately, it is not always possible to state positively that cutting oil "A" will give a perfect job. Frequently, it is necessary to try one, two, or more cutting fluids before you find the one that gives the best results. Some producers of cutting fluids have test equipment with which, in some cases, they can run tests to determine the best cutting fluid for a particular application, but in many instances it is much more feasible—particularly in respect to getting action in a hurry—to run your own tests. Also, if you run your

Resume of papers, on cutting fluids, presented April 9, 1946, at The A.S.T.E. New Era Exposition, Cleveland, Ohio.

own tests, you could exactly duplicate your machine operation and find out for yourself what cutting fluid gives the best results.

In most cases, any test procedure that is set up by the producer for his own research, is designed to meet a wide variety of conditions so that a cutting fluid developed by means of such a test procedure will meet the maximum number of jobs in the field. The purpose of this paper is primarily to discuss testing procedure for use of the consumer rather than one the cutting fluid producer would use.

Many types of relatively short chemical tests and mechanical bench tests have been tried for the evaluation of cutting fluids. Unfortunately, although a chemical test can show everything you want to know about the chemical analysis of the cutting fluid in question, it can't tell you whether it is going to work satisfactorily on your job. In most cases, the producer of cutting fluids can be relied upon to furnish a cutting fluid that will meet any chemical specifications that have been set up for it, and it probably wouldn't pay the most of you to run chemical tests on all the cutting fluids you use.

Many mechanical bench tests have been tried, with the hope that some short, relatively inexpensive test would show whether or not a particular cutting fluid will do the job expected of it. Unfortunately—to the writer's knowledge at least—no thoroughly successful bench test has been developed that will prove that a particular cutting fluid will act satisfactorily in your machine tools. Many test machines—such as the Timken machine and the SAE machine, which are designed to measure the lubricating properties of an oil—have been used to try to predict whether or not a cutting fluid would be good or bad in a machining operation. The results of these tests have been rather inconclusive as applied to cutting fluids. They do tell whether or not cutting fluid has high anti-weld properties and whether it has good lubricating properties. But, these factors have not always tied in directly with the success of the cutting fluid in a machining operation.

It has been our conclusion that the best way to test a cutting fluid is by an actual metal cutting operation—and that should bring the test procedure into terms all of you understand. What you want to know is whether or not the cutting fluid will help you to more efficiently remove metal, other chemical or physical aspects of the cutting fluid being more or less incidental as far as the users are concerned.

Any test procedure, designed to evaluate a cutting fluid, should measure one or more of the primary requirements and those secondary requirements that can be evaluated as a by-product of the test. The conditions of the test should simulate actual machining operations in so far as possible; however, it is frequently desirable to increase the severity of the test by increasing cutting speed or by varying the shape of the cut in order to shorten the length of the test. We are all interested, of course, in setting up a test procedure that is as short and as inexpensive as possible and still give the desired information.

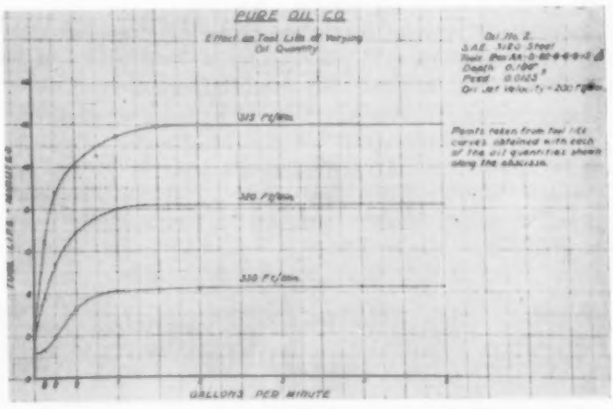
If we were to run a test, at normal cutting speeds, under exactly the same conditions that are used in a machining operation, it may be very time-consuming and quite expensive. It is highly desirable, therefore, to use a test procedure that increases the severity of the operation sufficiently to give a short-time test. In order to do this, we usually operate any cutting fluid test at relatively high speeds—considerably higher than would be used in production.

It is also possible to vary the shape of the tool to cause it to fail in a relatively short time and, therefore, to make the cutting fluid work harder than it would have to work in a regular production operation. It is well known, for instance, that higher rake angles tend to give low cutting forces, and possibly the cutting fluid does not have to do the maximum job under these conditions. In a test procedure, therefore, it may be desirable to reduce rake angles to such an extent that the cutting fluid is required to do a maximum job as far as cooling and lubrication between the chip and the tool is concerned.

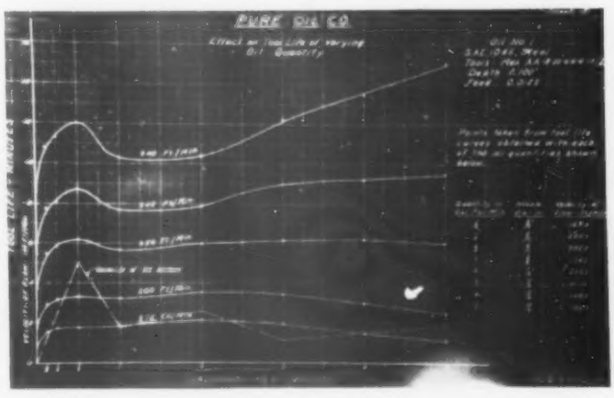
There has been considerable discussion on this point in the past, some authorities believing that, if the conditions of the test are too different from the conditions encountered in actual production operations, the results of the tests may be misleading. It has been our experience, however, that intelligent application of data, from a test designed to be severe, can be applied to actual machining operations. If a cutting fluid shows up well in a severe test, it is logical to assume that it will also show up well in a severe machining operation in your plant.

It is to be understood, of course, that all machining operations do not require the best cutting fluid. You know which operations in your shop are considered severe and which are considered relatively easy. There is no point in putting the best, most expensive cutting fluid to work on a job that obviously doesn't require that type of fluid.

The use, for test purposes, of a machine used in regular production is not recommended unless careful control of the operation can be maintained. If the performance of two or more cutting fluids are to be compared, it is essential that the cutting fluid only be varied while all other factors remain constant. This means that the material being machined, the tool material and shape, speed, feed, and



Curves showing effects of varying quantity and velocity of oil jet.



depth of cut must be held constant. When a change is made from one cutting fluid to another the machine and its sump must be thoroughly cleaned.

Some accurate method of evaluating tool life and work finish must be used. The opinion of the operator alone is, usually, not reliable enough since it is frequently affected by factors other than strictly scientific ones. If he doesn't like the odor, for example, he may say that the cutting fluid is no good, whereas what we really want to know is whether it improved the machining operation. The question of odor could be taken care of later.

Of course, there are many plants in which the production is sufficiently high and where some production machine can be set aside and used as a test machine on regular production jobs. If that machine is run by a reliable man, one aware of the importance of his job, much information may be obtained from a regular production machine of this type. However, we must emphasize the importance of very close control over tool shapes, machine speeds and feeds, and other factors that have been previously mentioned.

Whenever possible, it is desirable to set one machine aside for test purposes only. More reproducible results can usually be obtained on a simple machine tool performing a simple operation. For instance, a simple turning operation, using a single-point tool, is easier to use for test purposes than an automatic screw machine where a multiplicity of tools, some of them form tools, might be used. It is far easier to control the shape of a single-point tool than it is to control the shape of a form tool. The same might be said of a milling operation where a single milling cutter is used in preference to a complicated set-up where several cutters are used on one job.

Whatever machine is decided on for test work should be in excellent condition, ruggedly constructed and with sufficient power for operation under severe conditions of heavy cut and high speed. Tools should be mounted in heavy holders so that no chatter is present during any test. Chatter, due to insufficient rigidity of the work, tool, or machine, will give erratic results.

In choosing the type of machine and operation to be used in testing cutting fluids, it might be well to decide whether surface finish or tool life is more important to the immediate problem. The term, "tool life," refers to the length of time a given tool will continue to remove metal efficiently and still maintain the dimensional accuracy required in the work. The tool, however, may cease to produce a satisfactory finish on the work before it has failed in the sense defined under the term tool life. This may occur due to wear on the flank or front of the tool, or it may be due to an excessive built-up edge formed on the cutting edge.

In roughing cuts, tool life is usually the more important factor, whereas in finishing cuts surface finishes are frequently of prime importance. Of course, in any extensive evaluation of cutting fluids, both factors should be evaluated and it would be desirable to use a test procedure which will permit both to be measured. Various investigators have used lathes, milling machines, drill presses, threading and tapping machines and automatic screw machines for evaluating cutting fluids. Probably any type of metal cutting operation could be used.

Because single-point tool turning of large bar stock, in an engine lathe, is perhaps the simplest operation, the following procedure will refer to that type of test procedure.

It should be understood in this connection, that the same principles of test can also be applied to other machines and operations.

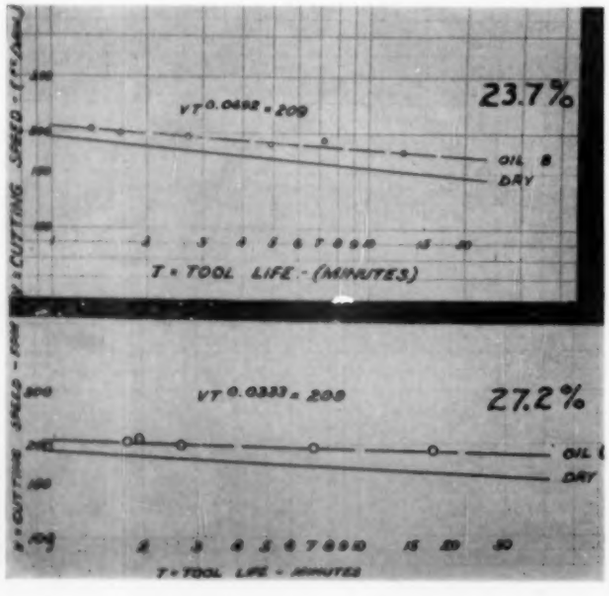
With a given cutting fluid, or when cutting dry, to obtain the tool life of single-point, high speed steel tools, it is desirable to run several tools to destruction at different speeds so as to obtain a curve of cutting speed versus tool life. Such a curve, when drawn on log-graph paper, will be a straight line. It is relatively easy to determine whether or not uniform results are being obtained by the nearness of the points to a straight line. If the points do not fall close to a straight line, it is usually an indication that the material being machined is not of uniform machinability, that tool material or shape is not uniform, or that the speed has not been held constant.

The curve obtained will have the formula $VT^n = C$, where V equals the cutting speed in feet per minute, T equals the tool life in minutes, the exponent n equals the slope of the straight line of the log-log graph paper and C equals a constant which is equal to the cutting speed at a tool life of one minute. By means of this formula, or by extrapolating the curve obtained on log-log graph paper, the approximate tool life at any cutting speed may be obtained.

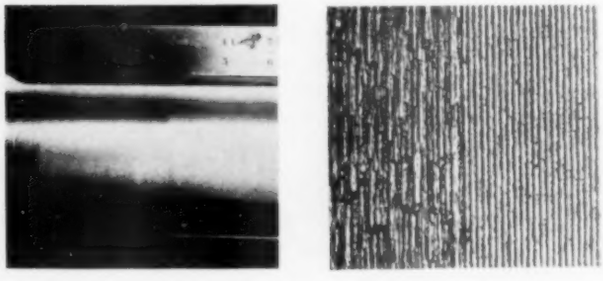
Accurate surface speeds must be maintained regardless of the work diameter, therefore, the lathe should be equipped with a variable speed drive. Some test machines have been used with DC motors to obtain the variable speed necessary. Others have been set up with one of the variable speed transmissions similar to the Reeves drive or some other type of variable speed transmission.

Any tool shape could be used, but it is well to keep in mind that, for the evaluation of cutting fluids, it is desir-

Curves showing tool life in minutes



Left, typical finish change occurring during tool-life test. Right, magnified view of finish change.



able to use a tool shape that will require a cutting fluid to do the most work. In other words, although a tool with relatively large rake angles may give maximum life, a tool with low rake angles will probably show more differences between cutting fluids in a high speed, short-time test, such as the type under discussion.

Accurate tool grinding is probably the most important factor in getting reliable test data to obtain identical tool shapes. It is necessary to use a good tool grinder which holds tool angles and nose radius absolutely uniform. It has been found advantageous to use an optical comparator to check the nose radius and tool angles on each tool before use in a cutting fluid test. It is, of course, of equal importance to maintain accurate setting angles of the tool in relation to the work.

Obviously, there is no point in going to a lot of trouble to obtain accurate tool angles if we do not carefully measure the angle of the tool, in the tool holder, in relation to its work. The importance of accurate tool grinding cannot be over-emphasized. That one factor has probably led to more headaches and unreliable test data than any other factor involved in a test of this kind. The tools must, of course, be of uniform quality and, preferably, all tools used in any given group of tests should be from one heat. It is well to use a tool grinder that will produce accurate tool angles without requiring too much skill on the part of the operator.

To obtain the tool life, cutting speed curve for a given cutting fluid (or under dry cutting), the first tool should be run at relatively high speeds to give a tool life of approximately one and a half to two minutes. Tool life figures under 1½ minutes are frequently unreliable. This may be explained by the fact that, to make a tool fail in such a short time, very severe conditions are required and, under such conditions, tools do not fail with uniform results. The tool setting angles are then checked and the lathe is started.

Surface speed may be measured conveniently by a tachometer equipped with a wheel 1 foot in circumference. The tachometer then reads directly in surface feet per minute, when the wheel is run on the uncut surface of the work ahead of the tool. Final speed adjustments should be made after the tool begins to cut, because obviously the lathe will slow down somewhat after the tool begins its cut.

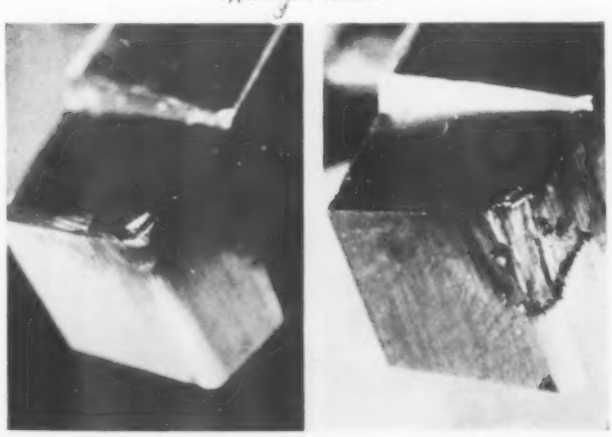
Tool life is timed by stop watch from the moment the cut begins until final failure. If the tool has cut the length of the test log before failure, it may be returned to the starting point and the cut continued with the same feed and depth of cut. Of course, the spindle speed must be increased to provide the same surface speed at the smaller diameter of the work. Failure of the tool is usually detected by burnishing of the shoulder formed by its cutting edge. If the cut is not stopped when this burnished surface appears, the tool will break down completely in a few seconds. It is relatively simple for an operator to become experienced in observing this failure point. The rapidity with which complete breakdown occurs is such that the accuracy of tool life is very close whether the operator stops the machine as soon as the burnished surface appears, or whether he allows the tool to completely break down.

In connection with this point, it is desirable to use a shape of cut such that the tool does most of its cutting on the side cutting edge rather than on the front cutting edge, so that the burnishing due to tool failure appears on the shoulder of the work rather than on the surface of the recently cut finish. This procedure is repeated at different cutting speeds until at least four points are obtained to determine the tool life, cutting speed curve. It is desirable to have a spread between the lowest and highest tool life point of at least ten minutes to obtain an accurate curve. A wider spread would be even more desirable. Obviously, the wider the spread between tool life points, the more accurately the curve can be drawn between these points.

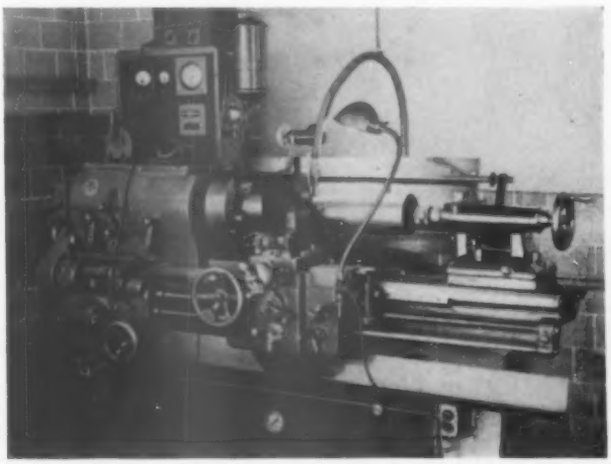
You will undoubtedly run into some difficulty, at one time or another, in getting points that fall on—or close to—a straight line. When such a condition occurs, it is necessary to consider, first of all, the accuracy with which tools have been ground and the uniformity of the tool material. If you are satisfied that tool grinding accuracy has been maintained, and that tool materials are uniform, the next thing to investigate is the work material which, obviously, must be of uniform structure throughout and free from slag inclusions. The problem of inclusions is sometimes a tough one to lick, since even small inclusions will shorten the life of the tool and throw out the results of any tool life tests.

You may argue that the material you are using in the test is also the material that you happen to use in production so that, if you can't get good results on the test, why should you get good results in production? The thing to remember, of course, is that the test procedure is designed to give a severe test. We want our results in as short a time as possible, therefore, we are operating under very severe conditions so that non-uniformity of material or the effect of inclusions is greatly exaggerated.

Typical tool failure.



The machine used for testing.



If the work material varies in machinability from batch to batch, or changes as the test log diameter changes, reliable data may still be obtained by running frequent "dry" curves. The dry curve is the base point for measuring any increase in tool life due to a cutting fluid and a slight shift, in this base point, does not mean that our results will be inaccurate.

If the work material is found to be good, we must look further for the cause of our inaccurate results. Perhaps the next thing to check is the rigidity of the tool and work and general rigidity of the machine, because if chatter is set up at times during the test, it will throw off the tool life results, sometimes decreasing tool life and other times increasing it. The volume or quantity of cutting fluid used during the test must also be controlled. The quantity and velocity of the cutting fluid stream should be maintained at a constant.

It may be interesting to see the effect of quantity on tool life, and Fig. 2 shows curves obtained by varying the quantity of cutting fluid in a series of tests. With any given nozzle size the quantity can easily be measured by the simple process of running a cutting fluid into a quart or a half gallon. There is no need for extensive instrumentation on this point. It is also important to keep the cutting fluid stream completely flooding the tool tip—or at least, that part of the tool that is doing the cutting. If the cutting fluid stream is deflected during a portion of the test, you will obviously get erratic results.

While we are on the subject of the direction of the cutting fluid stream, it might be very desirable, in some cases, to do some experimenting on the optimum direction of the cutting fluid stream. In other words, will you get best results in a particular operation by bringing the cutting fluid stream down from above, or aiming it from the side, or bringing it up from the bottom? In some screw machine operations, it is desirable to have cutting fluid streams coming in from several angles so that the cutting fluid will, at all times, hit the points of the tools that are doing the actual cutting. Considerable increases in tool life can sometimes be obtained by merely directing the cutting fluid stream at the optimum point.

In any cutting fluid test, the temperature of the cutting fluid should be held fairly constant. In most of our test work we hold cutting fluid at 100°F. + 5. degrees. Incidently, that temperature was picked because it was found that, in the particular size of cut we use, the cutting fluid did not tend to run any hotter than 100°F. and, therefore, it was a simple matter to maintain constant temperatures with a thermostatically controlled electric heater.

It is far simpler to add heat to the oil than to maintain a constant temperature by mechanically refrigerating the oil. Refrigerated oils, of course, will sometimes increase tool life, in production, because of the fact that a cold oil will give better cooling to the work and the tool than hot oil. However, we must be careful that oil is not cooled to the extent that its vicosity is increased to a point where we tend to get decreases in tool life.

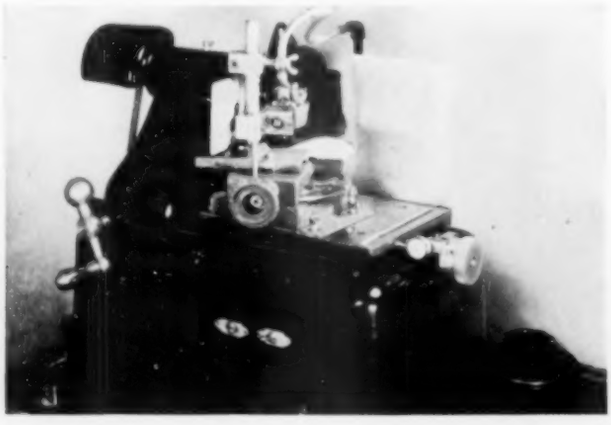
So far, we have discussed primarily the measurement of tool life as affected by cutting fluids. However, some of you are often interested more in surface finish, or dimensional accuracy, than in tool life. Therefore, it may be desirable to base your tests on the surface finish obtained rather than on tool life. When surface finish is being evaluated in conjunction with tool life, the surface roughness may be measured with a suitable surface analyzer after each tool life test. There are several commercial instruments for the measurement of surface finish, and any of these may be used to measure surface finish after the tool life test is completed.

In the majority of tool life tests, the feed used is relatively coarse, leaving rather wide feed marks on the work. The surface finish that we are interested in is measured along the feed marks rather than across the feed marks. In other words, surface roughness is caused by the metal being pulled away from the work, leaving a rough finish at the bottom of the groove cut by the tool nose. If we run the stylus of the surface analyzer across the feed marks, we would get about the same roughness reading regardless of the cutting fluid used. But if we run the stylus in the direction of the feed mark, in the bottom of the groove cut by the tool tip, then we measure the actual smoothness obtained by the tool during its cut. In dry cutting, that surface may prove to be quite rough, whereas with a proper cutting fluid, we get a relatively smooth surface in the bottom of the groove cut by the tool nose.

If you are interested only in surface finish, it may be more convenient to take facing cuts on a disk rather than to use a test log such as is used in tool life tests. If a disk is faced at a constant spindle speed, the surface speed obviously increases as the tool moves out from the center. The surface finish will change because of this change in cutting speed and, if a number of such disks are faced with different cutting fluids, we get a series of finishes at different cutting speeds, which give a complete picture of surface finish as obtained with different cutting fluids at various surface speeds.

In a test of this type, it may be desirable to use carbide tipped tools so that the tool shape does not change when

View of tool grinder.



Close-up, showing setup for grinding.

we run the tool completely across the face of the disk. A freshly ground tool should be used on each disk for any evaluation of surface finish.

Remarks have been confined to the use of a single-point tool cutting work in an engine lathe merely because that is probably the simplest metal cutting operation. Many investigators have used milling, drilling, and several other types of machining operations with equally good results and the principles set forth here may be applied to other types of machining operations. If a large portion of your problems are in milling operations, it would, of course, be more desirable to set up a test procedure using a milling machine rather than a lathe. The principles of obtaining tool life and measuring finish would still be fundamentally the same as we have discussed.

It might be mentioned that such a test set-up will be valuable from standpoints other than the evaluation of cutting fluids. For instance, you may want to do some work on the optimum feeds and speeds for a given job to give you the best surface finish, or, you may be interested in finding the best tool shape to give you long life and good surface finish. Whenever a new batch of work material is machined, production problems may arise that could be worked out satisfactorily on a test machine before production is started. Once a test machine of this type is available to you, you will doubtless find many problems that may be solved with this test equipment.

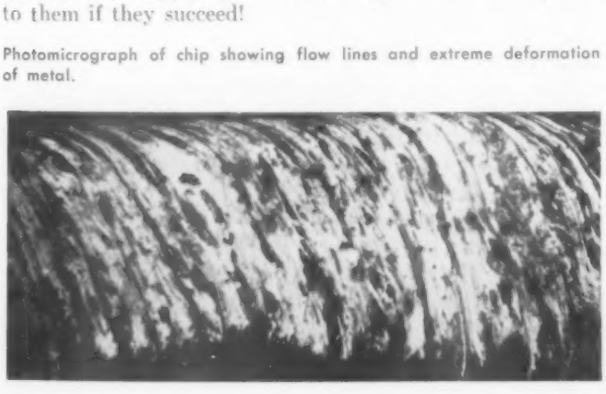
What the Tool Engineer Should Know About Cutting Fluids

By W. H. Oldacre

Before a group of tool engineers, it is unnecessary to emphasize the importance of the metal-working industry to our modern society, nor is it necessary to recite the accomplishments of the war period nor the contribution that is expected for the future trying years. It is also probably superfluous to attempt any listing of the elements of the machining process, or to point out that, since the development of modern machine tools, cutting fluids have always been a part of the metal-working picture.

When it is considered that cutting fluids always have been and still are an important factor in the metal-working process, it is difficult to understand the careless indifference, and even contempt, with which the subject is approached by most of the engineering fraternity. In a recent talk before a technical group, for example, a leading machine tool spokesman indicated that the purveyors of cutting fluids were a doubtful lot, laggard, nonprogressive and wholly out of step with the times and that, now, some machine tool builders were prepared to step in and remedy these delinquencies by supplying better cutting fluids. More power to them if they succeed!

Photomicrograph of chip showing flow lines and extreme deformation of metal.



Recriminations rarely make for progress, and it is not the purpose of this paper to condemn the actions of any group. It is important, however, that misunderstandings upon which such misstatements are based be corrected, and that, in this important field, accomplishments be emphasized as well as shortcomings. Else, irreparable damage may ensue.

In 1868, W. Henry Northcott, in a treatise on lathes and turning, discussed cutting fluids as follows: "The lubricating liquids are various. Oil is good but expensive. Soapsuds are also much used, but perhaps a solution of common soda and water is as good and cheap as anything. A little dirty oil or oil that has been run through bearings may be advantageous with the soda water."

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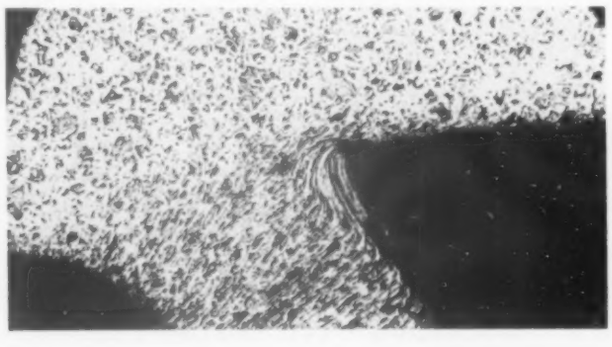
In March, 1946, editions of trade journals carry charts on cutting fluid recommendations emphasizing the use of lard oil, mineral lard oil, and soda water for a wide range of machining operations. When it is considered that the oil and dirty oil referred to in Mr. Northcott's treatise was lard or other fatty oil, the similarity between these two recommendations, made seventy years apart, is apparent, and the lack of progress painfully so. This situation, however, cannot be attributed to the cutting fluid manufacturer or engineer.

While charts are based upon the purported operations of one of our largest American industrial units, they do not even remotely represent modern cutting fluid practice. No cutting fluid engineer recommends the use of soda water excepting for rare and decidedly unusual applications. Such alkaline solutions are hard on both the machine and the operator, and their performance, excepting in the unusual cases referred to, will scarcely equal that of simplest and lowest priced soluble oil products.

Lard oil and mineral lard oil have, of course, been long recognized as good cutting oils. However, the terms are

Photomicrograph of chip structure showing built-up nose.



rather ambiguous. Today, and for many years past, pure lard or grease oil has been sold in at least seven grades, based upon the free fatty acid content. Mineral lard is, of course, a mixture of any one of these grades or perhaps a substitute, fatty material with some light petroleum oil. There are few if any references in literature, either current or past, definitely indicating the grade of pure lard used, or the fatty content of the mineral lard.

Digressing from cutting fluid appraisal for a moment, it might be profitable to take a critical look at the machine tools in which they are used. Machines have been improved in construction and in precision, and their productive possibilities tremendously increased, but cutting fluid systems, and provisions for application, still follow old time formulas. Reservoirs are usually a part of the base structure of the machine, frequently inadequate as to size and often inaccessible for the frequent cleaning required.

All will agree that, from the standpoint of over-all efficiency, much improvement can be made. Some betterment has been noticeable in recent years, but the intimate relationship between the component parts of the system and the cutting fluid has been neglected. Coolant pump motors are generally designed to handle low viscosity fluids with little attention paid to the possibilities of sharply increased viscosity and consequent difficulty of pumping with refrigeration or with heavier oils. Metals are used in pump and distributing pipes without regard to their chemical relationship with the cutting fluid. And, of course, the cutting fluid is blamed for the trouble which sometimes results. Closer cooperation between the machine tool designer and the cutting fluid engineer will certainly result in definite mutual advantage along these lines.

It is time that the machine tool engineer, and the metalworking industry in general, cease regarding the cutting fluid as a necessary evil and deal with it realistically and appreciatively. In this connection we might profitably spend a little more time in the shop and be guided more by production experience than by wishful thinking.

Real progress has been made in the production of satisfactory and efficient oils and emulsions, and this in spite of the difficulty of securing accurate production data from the shop. Virtually all of the information which reaches the modern plant engineer or purchaser is the result of observation at the operator level. Rarely, indeed, is a competent engineer assigned to the study and observation of cutting fluid performance. Even if so assigned, he is given insufficient time or help to properly do the job, and is therefore forced to accept the observation of the operator and other poorly trained observers.

As we said before, these somewhat critical comments are intended to be constructive and not recriminatory. They are, frankly, expected to challenge your attention to this important matter, and perhaps to better introduce the somewhat presumptious subject, "What the Tool Engineer Should Know about Cutting Fluids." The simple answer to the question obviously is that, as cutting fluids are an important element in the machining process, a good tool engineer should know all about them, but it is equally obvious that there is nobody to whom he can turn for such comprehensive information.

Gear shaping operation. Photograph courtesy Fellows Gear Shaper Co.

Unfortunately, when we approach the subject of the mechanism of metal cutting, we are faced with an appalling array of negatives. We have no comprehensive understanding of the plastic behavior of metals, and no generally accepted theory of the mechanisms of metal cutting. Excepting for the most elementary and wholly inadequate hypotheses, we have no idea of how a lubricant functions. Sad, indeed, would be our lot if our productive output waited upon theoretical explanations of productive processes! Our machines do operate wonderfully well. Our cutting fluids do function and with a minimum of cost and attention. And, it is in a careful study of successful performance that we must seek the answers to our problems.

It is easily observed that the machining process is due to formation of chips from the action of the cutting edge. During this chip formation, the worked metal is severely deformed plastically, and large amounts of heat are developed. Furthermore, there are rubbing contacts, under high pressure and temperature, between chip and tool metal and other contacting surfaces. The tendency of rubbing metals to seize under such conditions has long been recognized, but it remained for the automotive gear engineer to develop machines to study the phenomena and point out some reasons and remedies.

Extreme pressure lubricant testing machines are probably familiar, and the result of lubricant tests on these machines are easily available. Such tests clearly indicate the importance of sulphur in oils as an antiweld or antiseizure agent. It is easy to see how this agent reduces welding tendencies between the heavily loaded surfaces of chip and tool, and thereby improves finish and tool life.

The function of chlorine compounds and other agents is not so well understood, although it can readily be observed that friction and resulting temperatures are reduced when they are present.

Cooling or temperature regulating effects of the cutting fluid are obviously important. In fact, it is a frequent assertion that this is the sole function of the "coolant." However, wide differences in the behavior of cutting fluids, unrelated to their thermal characteristics, make this simple assumption untenable. The importance of heat regulation in the machining process is apparent even to the novice, and it is probably due to this fact that so much emphasis is and has been placed on cooling. The magnitude of the temperature changes involved, the many possible heat sources, and the effects of temperature change on metallic properties and behavior increases the complexity of the problem and make any easy answers out of the question.

Part of the heat developed is, as has been said before, due to metal deformation, another part to friction between heavily loaded rubbing surfaces, and which contributes most to the overall temperature increase cannot be easily determined. Both are always present and closely related.

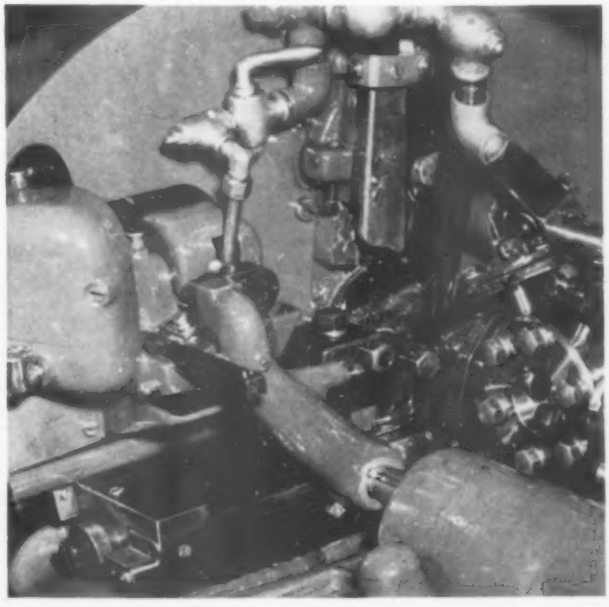
As high machining temperatures proceed from two fundamental sources, they may likewise be regulated by two fundamentally different methods. Friction between rubbing surfaces may be reduced and motion made easier by lubrication, and coolant may be applied so as to carry away the heat as it is generated. However, due to the comparative inaccessibility of the cutting orbit, the volume of coolant in immediate contact with the areas where the temperature is generated is probably insufficient to accomplish much, so that the principal cooling is done by conduction from the hot spots through the cooler parts of the tool and workpiece. On the other hand, lubricating functions involve much smaller quantities of fluid, and these small amounts may be present where required.

Out of this dual situation has arisen the development of two distinct types of cutting fluids, namely, the water emulsions and the straight cutting oils. History clearly indicates the development of straight oil cutting fluids from the practice of applying well-known fatty oils to the metal-cutting process, and also the development of soluble oils or emulsions from the desire to add some lubricating quality to the cooling properties of water. Peculiarly, industry has consistently practiced this dual approach to cutting fluid problems, but has persistently refused to recognize its soundness.

There is altogether too great a tendency to design machines with inadequate fluid handling systems on the basis of some Utopian promise that the need for cutting fluids will soon be eliminated, but even the most casual investigation of the facts confirms the probability that we will have both soluble oil and straight oil in our metal-cutting plants for long years to come.

The term "soluble oil" is, of course, a misnomer, as one of the basic characteristics of an oil is its insolubility in water. However, oil-water emulsions are quite readily formed and stabilized by means of soaps. Soluble oils are carefully balanced oil-soap mixtures that, added to water, readily form comparatively stable emulsions.

Automatic screw machine operation.



In the emulsion, the oil is suspended in a soap solution, although in certain instances the reverse may be true. Virtually all water-mixed cutting fluids in use today have the water as a dilute soap solution in the outer phase, with the oil in the inner or suspended phase. Frequently, the suspended oily phase is in itself a water in oil emulsion with the water in the inner phase. This structure is evidenced by creaming upon standing.

The suspended phase in an emulsion may consist of almost any oily material. In the lower priced soluble oils it may be straight petroleum, while in higher priced products it may be straight fatty oil or other cutting oil of greater efficiency.

Soaps used in the protective and outer phases may be of several types. Formerly sodium or potassium soaps of liquid animal or vegetable fatty acids were widely used, with the sulphonates of animal or vegetable fats also playing an important role as emulsifiers. Today these have been largely superseded by sulphonates of petroleum origin.

The oil in a cutting fluid emulsion is there to perform a lubricating function, and while an emulsion is usually assumed to take the characteristics of its outer phase, it is probable that, at the cutting orbit, the emulsion breaks down under heat to release a part at least of its oily content and to perform the lubricating job required of it.

It should be noted, however, that emulsions are not oil-water mixtures. The outer phase is not straight water, but a soap solution and, compared with water, this soap solution is much inferior as to cooling qualities. There is considerable evidence to support the assumption that, at temperatures above the boiling point of water, a steam foam blanket tends to insulate the hot spot and reduce the effectiveness of the coolant.

In the past, much emphasis has been placed on the stability of cutting fluid emulsions. It is really surprising what perfect emulsions can be formed. The need for such perfection is, however, open to question, as a small amount of free cutting oil in the cutting fluid seems sometimes to add to its efficiency. Of course, such separation should not be allowed to develop to the point where non-uniformity interferes with performance. A good soluble oil should be based on performance tests and not on appearance. The complex structure of the oil-soap mixture offers almost infinite possi-

Turning operation on turret lathe. Photograph courtesy Warner & Swasey Co.

bility for variation both as to composition and performance, and it is almost certain that increased attention to the composition and performance of these products by both producer and consumer will be handsomely rewarded by increased efficiency and output.

Formerly, almost all straight oils were of animal, vegetable or marine derivation. Before the advent of petroleum lubricating oils the fatty oils were the only lubricants, and it was natural that such lubricating oils be used for the metal-cutting processes then in use. When petroleum lubricating oils appeared, they readily replaced fatty oils for spindle and other bearing lubrication, but on metal-cutting operations the fatty oils were essential and could not easily be set aside.

World War I, and the voracious appetite of the automotive industry for machined parts, gave impetus to the development of sulphurized oils. The literature of lubricants contains many references to the use of sulphur in oil, but the first stable sulphurized oils became commercially available for cutting purposes during the latter part of the first World War. During the past twenty-five years, their use has become widespread and development and improvement continuous. With better tool materials they have contributed greatly to the Machine Age.

All oils are complex organic compounds, and it is possible for sulphur to be present in many different forms. Some of these forms are much more effective in the machining process than others, and so it is highly inaccurate and unsatisfactory to speak merely of sulphurized oils as though they were all alike or similar, neglecting the wide variations in their composition and performance. Unfortunately, we have no generally accepted or satisfactory method for measuring sulphur characteristics in oils, and so here again we must depend largely upon performance for an indication of quality.

Several laboratory tests for active sulphur have been based on the reaction of sulphur compounds with copper and properly used, these tests may be very helpful in evaluating sulphurized cutting oils. Likewise, the extreme pressure lubricant testing machines, developed for gear lubricant testing, are of considerable value in appraising both the antiweld and the lubricity values of these products.

If the antiweld value of the sulphurized oils were the only characteristics to be considered, it would only be necessary to put as much effective sulphur into the oil as was reasonably feasible. Unfortunately, however, high sulphur activity is also associated with high tool wear, which manifests itself in the case of free-cutting materials by rapid wear on the clearance near the tool edge. This wear limits tool life to a fraction of that possible with oil of the correct sulphur content. It is desirable, therefore, to carefully balance sulphurized cutting oils so that the necessary antiweld value is available without excessive tool wear.

Mr. C. F. Kettering, head of the General Motors research department, frequently states that "it isn't what we say but what the machine says about an oil that is important." This means, of course, that most of our questions must be asked on the job and in the shop, and, if the answers are to be accurate and understood, there must be most careful observation and accurate interpretation.

It is here that our metal-working industry falls down. Most large manufacturing plants have splendid chemical and metallurgical laboratories, but rarely are these facilities coordinated with shop practice. All too frequently the machine superintendent, or foreman and operator, will be ignorant of the simplest metallurgical characteristics of the material being machined. Metallurgical laboratory facilities are too often an adjunct of the purchasing rather than of the production departments.

Quoting a phrase used in a competitor's advertisement: "We need more shirt-sleeve engineering in the field of metal-cutting and of the application of cutting fluids." The tool engineer can make a real contribution by going into the shop and getting close enough to the operating machine to determine just what is going on, even at the risk of a few drops of "that dirty oil" on his white collar.

Get closer to the cutting fluids and you will find a fascinating subject, one which will repay your interest with big dividends in the way of increased production. Get closer to the cutting fluid engineer. You will find that your problems are his problems, and his successes your successes. Co-operation always makes for progress, and nowhere is this more evident than in the important field of cutting fluid application.

Cutting Speeds and Feeds

By Frederick W. Lucht

Connected with a company that makes cemented carbides, (and we have usually advocated cutting dry) the writer was really "put on the spot" when asked, by Mr. Wangelin, to join in the discussion on the "Testing of Cutting Fluids." It is true that . . . we find jobs where it is necessary to maintain dimensional accuracy on the part being machined. Even then we could use pure water, which is one of the finest coolants, if it were not necessary to keep the ways on the machine tool free from rust.

To prevent this from happening, we have had to add a little soluble oil to the water—in proportion, about one part soluble oil to thirty or forty parts of water. The variation in the solution, due to the difference in the hardness of the water in various parts of the country, brings the oil companies into the picture.

Frederick W. Lucht **was graduated from the University of Michigan with degree B.S. in Mechanical Engineering and has since specialized in research and practice on high speed steel and carbide cutting tools. He has been Chief Engineer and Sales Engineer with Goddard & Goddard Co., development engineer with McCrosky Tool Corp'n and Midwest Tool & Mfg. Co., and, for the past ten years, development engineer with Carboloy Co., Inc., Detroit. He is a member of the A.S.T.E., the A.S.M.E. and the Engineering Society of Detroit.**

When we recommend the use of a soluble oil solution, we advocate plenty of it when it must contact the tool. It should never dribble on the tool. It is better to direct it toward the cut underneath the tools, or at the cut from the side of the tool, where the chip flow has the least tendency to interrupt the flow of the cutting fluid. An intermittent flow of the cutting fluid will always tend towards a reduced tool life.

We have never had much success when using cutting fluids other than soluble oils except in the gun drilling operation. Here, the regular cutting fluids which are normally used for gun drilling gave the longest drill life. There are cases where the troublesome built-up edge reduces tool life. This is where, because of the machine tool available, we are forced to operate at speeds much lower than those we normally advocate. We would welcome a cutting fluid which would eliminate this build-up edge condition.

For rating carbides, however, we have conducted a large number of tool life tests on a 22-inch Monarch Engine Lathe in our Engineering Laboratory. We find that when the cutting speed is expressed in feet per minute and the tool life is expressed in minutes, the test results always plot as a straight line on log-log graph paper. These results are extremely accurate providing that all the test conditions are kept uniform.

We find it important to grind a complete set of tools, which will be used for a given set of runs, at the same time, to aid in keeping them identical. We use a .015" x 45° chamfer on the nose of the tool, instead of a radius, because it is easier to grind and also because it enables us to obtain greater uniformity in grinding. All the tools we test must pass a critical inspection under 20 magnifications, and they are resharpened until they are satisfactory.

To completely remove the human equation, we do not rely on the operator's judgment to determine when a tool is dull. All of his time is devoted to the maintenance of the test conditions. He can quickly select a cutting speed that lies within the 1½ to 2 minute time interval referred to by Mr. Wangelin, and take a cut which is sufficiently long to cover a .002" wear at the end of the tool. Experience, combined with a second trial cut at the next lower speed, will enable him to locate his range of activity with a minimum amount of trouble. No preliminary runs should be made at low speeds, as the results may be too erratic because of the formation of a built-up edge on the tool.

The operator uses a tachometer to obtain his cutting speed in feet per minute at the cut diameter left by the nose of the tool. After he has completed his cut, he mounts a dial indicator in the tool post and indicates the surface turned, in the direction of the feed, while using the start of the cut as the zero reading. He then locates the position where the indicator shows a .004" plus reading, which corresponds to .002" wear on the nose of the tool.

He then measures the distance to the beginning of the cut. This distance is converted into minutes of cutting time by dividing it by the feed and the actual work RPM, and is plotted against the cutting speed. Several of these points will arrange themselves in a straight line which can be used as a means of rating a certain set of operating conditions. It produces accurate results when rating carbides and should be equally accurate for rating cutting fluids.

To repeat, this method does not require the operator's judgment as to when a tool is dull. He does not have to completely ruin the cutting edge on a tool by running it to the destruction point. For that matter, the information obtained from any tool which is run to the destruction point has no value. We want to know what happens just before the destruction takes place. The appearance of a tool so tested indicates what the next move should be, and enables us to make progress because we are continually building on past experiences. It is quite easy to apply the tool life test curve idea, to any machining operation, to determine the best operating speed to meet a certain set of conditions. Run the tools at two different cutting speeds, and record the number of pieces obtained at each speed, up to where the tool produces work which is off tolerance. A straight line will be obtained if the total, actual cutting time is plotted against its cutting speed in feet per minute; the resulting tool life curve can aid in determining results at other speeds and in establishing the most economical operating conditions.

When operating at too low a cutting speed, the material which is being turned will actually build up on the nose of the tool. This will mean that the tool will turn a slightly conical type of surface instead of a straight cylindrical. We have cases where the diameter, at the end of the cut, was .018" smaller than at the start, with practically no sign of tool wear at the nose. In other words, tool life tests, based on an increase in work diameter as the cut progresses, do not work satisfactorily at low cutting speeds.

The Selection of Cutting Fluids

By Joseph Geschelin

The contributors to this Symposium-Messers Wangelin, Oldacre and Lucht—are to be complimented on the preparation of important treatises on the testing and applications of cutting fluids. They have covered the general questions of the function of cutting fluids and the amazing variety of variables which enter into the seemingly simple process of making chips. Recommendation, as regarding the use of a standard machine tool as a yardstick of cutting fluids performance is excellent and in keeping with modern ideas on the subject.

Joseph Geschelin **is Detroit Editor, Chilton Publications, Automotive Div'n. A graduate in mechanical engineering from Cooper Union, and a licensed professional Eng'r, N. Y. State, he is a past vice president, S.A.E., member of the A.S.M.E. Executive Committee on Machinability and founder and Chairman of the Independent Research Committee on Cutting Fluids.**

What I should like to emphasize is that, even today in the mass production industry, there is not sufficient understanding of the role that cutting fluids play in the process of removing metal. One of the reasons for the formation of the Independent Research Committee, about eight years ago, was that of making metal working plants more familiar with cutting fluids—what they are, and how best to utilize them economically. In the process, it is our aim to sell industry on the principle that the cutting fluid is as important as any other element in the metal cutting process. Some of the relationships outlined in these papers should make this clear.

It is imperative to assign the responsibility for the selection and use of cutting fluids to a technical department such as the chemical or metallurgical lab in each plant. The personnel of such departments are familiar with the testing

of raw materials and lubricants and would be most helpful in setting up the necessary test procedures, including the test or reference machine described by the author. When you consider that many important machining setups sink or swim with the choice of cutting fluids, you can appreciate the necessity for centralized technical control. It must come without delay.

As Mr. Wangelin says, the selection of the right kind of cutting fluid is not a simple proposition. There are scores of producers and many, many different types of branded materials. How to pick exactly the right one for your use becomes a first rate job. At best the generalized recommendations simply chart the course and direction of the process of selection. For example, our Committee has developed a machinability table and an accompanying chart giving recommended types of cutting fluids for commonly-used metal cutting operations. We warn that these recommendations are of general nature and must be modified in most cases. They do, however, give you a logical starting point. And that is a good part of the solution.

However, there are other complications. From the standpoint of economy of operation, most mass production plants find it desirable to standardize on the very minimum number of types of cutting fluids. In fact, just before the war the tendency was to the adoption of just one type—usually a soluble oil, used in perhaps two or three mixtures. This did not work out too well since there are numerous operations where special types of cutting fluids are essential if productivity, finish and cost are to be considered.

Nevertheless, the objective should be to reduce the number of types of cutting fluids in any plant to very minimum. A formal test procedure, such as the author has described, marks a logical approach to this end. It has many advantages. For one thing, the test procedure enables one to make a selection of materials out of the offerings of many producers. Then, if you have decided to adopt certain types and brands of materials, the test procedure enables you to sort out the products best suited to your problems, to reduce the types of materials to the minimum and, finally, to decide upon the proper mixture for each operation.

Now, we should not overlook another phase of the problem of testing. In addition to the standard test machine, some plants may find it desirable to use a production machine for the purpose of testing competitive cutting fluids or different types of cutting fluids under actual operating conditions. In many instances, there is a need for trouble shooting when breakdown or poor quality occurs on a job which has performed properly up to that time. In other cases, you have an established mass production setup which will run continuously and for long periods of time. That kind of job might be improved, in many ways, by tailor fitting the cutting fluid to the setup. The best way to do it is by running the very production machine in which the job will be done.

As has been brought out, however, there are many pitfalls barring the way to the right results. One of these is the attitude of the operator. Another is the fact that since many people look upon the cutting fluid as just another material, no effort is made to clean the machine and remove the old cutting fluid before charging it with the test material. Here, again, are the best reasons for having a technical department in complete control of all test work whether in the lab or in the shop.

I want to emphasize another important point. Let's forget chemical and physical specifications of a cutting fluid, since, in the final analysis, what you are after is the best overall result in making a pile of chips. If the material contributes to high productivity, if it gives you the finish you want, and if it has no harmful effects either on the operator or the work, that's it! As a matter of fact, it's an open secret that chemical specifications are hard to write and even more difficult to check. The best plan is to buy from reliable sources, that will give good service and whose products give the desired results.

Cobalt, Ontario—Ghost Town Resurrected

The story of cobalt metal, and the town by the same name, out-Horatios the best of the Alger stories. Known for 6,000 years as an unwanted orphan metal—a nuisance shrouded in legend—this metal has, in recent years, made good in hundreds of industrial applications. Today, demand far exceeds supply.

The story of Cobalt started in 1903 when a worker in a railroad cut threw his hammer at a thieving fox, missed, and chipped off a piece of rock that opened one of the world's richest lodes of silver and cobalt.

News of the strike was flashed throughout the world, and within four years forty-four mines were in operation, of which the Townsite Mine—one of sixteen now being reopened by the Silanco Mining and Refining Company—made a record by paying its stockholders more than 150% a year! But with a drop in the price of silver, after World War I, the mines closed down and, by 1922, Cobalt was truly a ghost town.

Three years ago, Louis Cadesky, Toronto business man and erstwhile trapper and trader, started to acquire the long idle and flooded mines of the area—most of them at the cost of the proverbial "song." He paid special attention to mines with a preponderance of tailings, now found to be rich in cobalt and silver.

Once worthless, cobalt now is worth from 80c to $1 per pound, and demand is growing. Among the other properties acquired by Cadesky, and later consolidated by Silanco Mining and Refining Company, were sixteen mines and thirteen claims which are still virgin and unmined.

The largest single use of cobalt, during recent years, has been in cobalt-chrome alloys, such as "Stellite," a combination that makes for hard cutting tools. It is also one of the few metals to provide a composition sufficiently heat resisting for use in jet propulsion planes. It went to war in radar, in blades for superchargers and in internal combustion engines.

Because of its magnetic qualities, it is used in telephone equipment and where high performance magnets are required. It is also essential in making heavy duty shears, rust resisting steels, bearings, electrical resistance wires, fractional horsepower engines, and is a source of cobalt dyes in treating textiles, glass, ceramics and paint.

A Broaching Institute Article

Flexibility in Small Lot Production Broaching

Universal Fixtures and Advanced Methods Effect Marked Economies in Short Run Production

Thinking men in every walk of life are beginning to understand that, in the postwar period now unfolding, the only way to raise the standard of living is by lifting the productivity of the worker so as to produce more goods at lower prices and thus have a wider distribution of goods. How can we increase the productivity of the worker without increasing his hours of work and without adding to his physical burden? That answer is found in modern manufacturing machinery and advanced production methods.

Increased productivity has the effect of reducing costs and, consequently, of widening the market for the product. The net result is increased demand for goods followed by the employment of still more workers. This process has been proven in a practical way in the mass production industries as, for example, the automotive, household refrigeration, washing machines, radio and other mass consumer industries.

The art of broaching—in *all* of its branches—is an outstanding example of the advanced manufacturing practices we have in mind. Whenever it can be effectively applied, broaching will produce more pieces per hour than any conventional method for doing the same job. Accuracy is another attribute. Given fixtures and tools properly designed for the job at hand, broaching can be expected to produce unfailing accuracy of the order demanded for interchangeable parts. However, over-all economy is the most important feature of the broaching process. For, in this respect, it exceeds by far the optimum economies possible with conventional methods of metal removal.

Mass Production Methods Applied to Small Lots

Although most people understand the role of advanced methods and specialization as applied to mass production—the making of thousands or millions of pieces of the same kind for long periods of time—it is not as well understood that the same benefits may be applied to smaller volume with comparable improvement in output and cost. Proper analysis of many operations, in any plant, may develop the possibilities of applying mass-production methods to small-lot production and give the smaller plant an opportunity to compete on a more equal basis.

It is the object of this article to show, briefly, how the broaching process can be adapted to small-lot production, thus spreading its benefits more widely. Because broaching requires good equipment, entailing a sizable investment of capital, there may be an impression that it cannot be applied economically to smaller runs. Consequently, it is important to understand that broaching holds great opportunities through its *flexibility* and unplumbed *versatility* of application.

For, it is perfectly feasible to use one good machine of the right capacity for the broaching of a variety of parts of the same kind but in different sizes or, by the same token, for a wide variety of dissimilar parts. It is a matter of understanding the process, of the proper selection of parts, and the development of the right kind of tools and work-holding fixtures. In some cases it is even feasible to develop universal fixtures suitable for handling a large number of parts. It's all a matter of know-how and ingenuity.

Let us add, at this point, that this principle is neither new nor unknown. It has been applied successfully in many industries in recent years. However, these applications have neither been widely publicized nor exploited to their full extent. It is our purpose, therefore, to give a brief picture of what has been accomplished, in a number of specific cases, so as to show the unlimited potentialities of broaching. In this connection, the Broaching Tool Institute will be glad to assist anyone interested in exploring the process and will lend its cooperation in the solution of individual problems.

Just before American industry embarked on the war program, the publication *Automotive & Aviation Industries* published an article describing the manufacturing setup of Johnson Motors, well-known producers of outboard motors. Although one of the most important names in that industry, accounting for a large volume of engines, Johnson does not have large runs of the same parts owing to the multiplicity of engine models required by its customers. Nevertheless, this company found it desirable to adopt broaching in the interest of over-all economy and did so in rather dramatic fashion.

At the time the article was written, they had installed two vertical pull-down broaching machines, one of 15-ton capacity with 54-in. stroke, the other of 10-ton capacity with 42-in. stroke. The 15-ton machine was appropriately tooled for hole broaching, usually with round broaches. The interesting point is that the machine was arranged to handle

FIG. 1. A typical setup, for hole broaching, consists of two sets of three broaches—one set for rough broaching, the other for finishing—and an electrically interlocking automatic fixture, holding six bushings, that indexes the table from rough to finish broaching position.

the following group of related parts: connecting rod bearings; cylinder sleeves; connecting rod bushings; inserts for the gear case; propeller shaft sleeves; top, bottom and center main bearing bushings; propeller inserts and pinion shaft bushings.

A typical setup, shown in Fig. 1, consists of an indexing fixture holding six bushings, with two sets of broaching tools, each set comprising three broaches—one set for rough broaching, the other for finish broaching. An electrically interlocking automatic fixture is employed for indexing the

Elaborating on one of the specific cases mentioned, Fig. 2 shows a fixture used to broach half round grooves in two shackle bolts at one time. The parts (shown at lower right) are held with a hand clamp, and the broach bars are of insert construction. Output is 160 parts broached per hour, as compared to a previous rate, by milling, of 50 per hour.

In Fig. 3, is shown the fixture used for the initial machining operation on "spring chairs." The operation consists of slotting the sides of the casting, by broaching, one side at a time. In machining the first side, location is from the rough castings, then, after an accumulation, the locating block in the fixture is changed and the parts located from the broached surface to finish the opposite slot. Productive rate, 60 per hour as compared to the former rate of 15 by milling.

Fig. 4 illustrates the initial broaching operation on auxiliary spring chairs. Both sides of the upper and lower sides of the casting, which is of U shape, are broached simultaneously. In loading, the upper fork is supported on a solid block on the fixture and held in place by a top clamp, with the lower fork resting on a wedge type compensating jack. A screw operated, receding clamp locks the part lengthwise. Broaches are of insert construction, and rate of output is 45 per hour as against a former rate of 14 by milling.

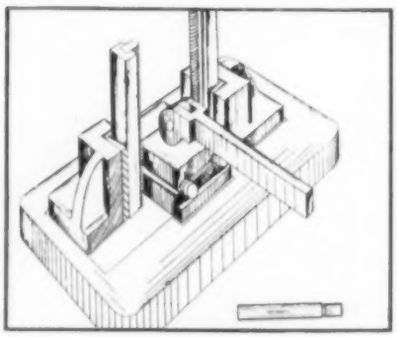
In Fig. 5, is shown the fixture for broaching the internal splines on steel brake slack adjuster gears. The broaches are provided with a semi-automatic handling mechanism so that, when they have been pushed through the work (two parts are machined at one time) they are automatically released by the actuation of a plunger attachment on the ram. The broaches then drop into a handling cup below the fixture, the vertical movement of which is controlled by the ram movement. The parts are then removed, when the broaches are raised by the cup and snapped into the ram attachment, which returns them to the top of the stroke. The fixture is then reloaded. Rate, by dual broaching, is 200 per hour as compared to 50 with old style single pull broach.

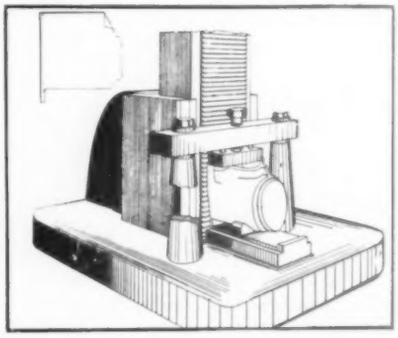
Fig. 6 shows a fixture used in connection with a rather sizable surface broaching operation involving gear housings, shown in outline at upper left. Both faces are machined in the same fixture, but in two different operations. For the first, the part is located in a V-block and locked with a swing type clamp, from the top. For the second operation, positioning is from the outside of the locating block, with the cored casting clearing the Vee and clamping as before. The same broach is used for both operations, and output, as compared to a former rate of 10 per hour by milling, is 40 per hour.

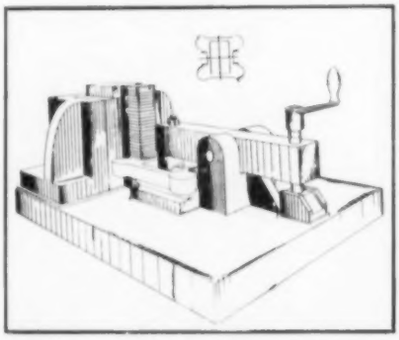
Fig. 7 shows an ingeniously designed fixture for broaching the intricately shaped anchor pin brackets illustrated at the left. The shape of the parts require clamping from the rounded surface in a manner to avoid interference with the broach; also, since two surfaces are broached at one pass, it is not possible to clamp from either of the flat surfaces. As a consequence, the lower support is made V-shaped to support the curved portion. The combination of side and lower jacks permits locking the part with but a single cam-operated clamp. Output is 50 per hour, as compared to a previous rate of 10, by milling.

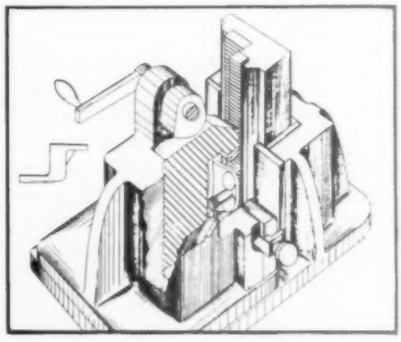
The initial machining operation on spring chairs is performed in the fixture shown in Fig. 8. This operation consists of broaching the inner face, with two broaches inserted in the broach bar. Locating is against the back face. The clamping arrangement, which is ingenious in its simplicity, employs equalizing supports, with actual clamping effected by moving back the equalizer on the far side. Again, rate of production is sharply increased, output being 45 per hour as compared to the previous rate of 14, by milling.

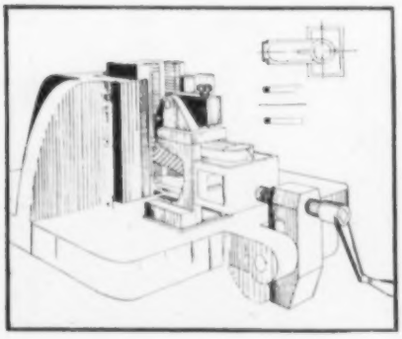
Taken as a whole, the fixtures used are not only extremely versatile, with a resultant economy in tool inventory, but the change from milling to broaching, or from single to multiple broaching, as in some cases, has markedly increased production even on comparatively short production runs.

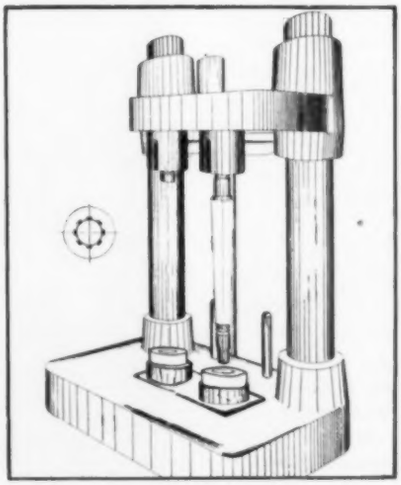












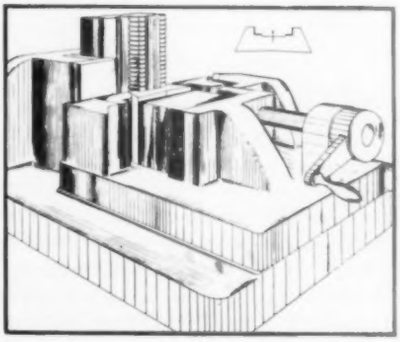


Fig. 2, 3 and 4, top to bottom at left; Fig. 5 below. Figs. 6, 7 and 8, top to bottom at right.

table from the rough to the finish broaching position. The one machine, therefore, is *flexibly* tooled to take care of all of the hole broaching jobs in the plant.

The smaller (10-ton) machine was used exclusively for a variety of surface broaching operations. It was tooled for broaching the surfaces and faces of about thirty different parts. The number of broaching tools was held to a minimum by so selecting parts—by families or similitude—as to make it possible to use the same set of tools for eight to ten different parts. This centralization of operations, a conscious process of bringing a large variety of parts to the same machine, resulted in a marked saving in time and cost and handling in contrast with the former practice of routing over a number of conventional machines.

60 Parts with 7 Fixtures

Another outstanding instance of the application of broaching to job-lot production was reported some time ago in the plant of a well-known manufacturer of parts for motor truck trailers. Here, a single broaching press of 15-ton capacity was fitted with seven fixtures and used for the surface broaching of seven different parts required in a total of 60 different sizes. It is important to note that the cost of the press, with its seven fixtures, was approximately one-fourth of the investment in the former conventional equipment, including the fixtures. Productivity was increased without raising the labor cost.

Remember that this installation handles *sixty different parts with seven fixtures*. The quantities of each of the parts needed at any time range from 300 pieces to as much as 20,000 pieces. However, most runs, between changes in fixtures, run from 300 to 1000 pieces. In most cases the production rate was quadrupled and, in one instance, it was tripled. For most operations, the full stroke of the press—36 inches—was required; for operations taking less stroke, the length of travel was readily changed merely by resetting the adjustable stops.

Since a picturization of the tooling, for this job, is easier to visualize than a bare word description, we have shown sketches—Figs. 2 to 8—of each of the operations performed on each of the seven fixtures. These, with descriptions of the operations performed, should prove of great interest to everyone concerned.

A third case, of outstanding interest, shows how a machine tool manufacturer was able to adapt a single vertical broaching machine for the finishing—by surface broaching—of twenty-four different trip dogs, and thirteen different tongue strips. (See Figs. 9 to 12.) The average lot of trip dogs is only about 150 pieces; and of tongue strips, about 2000 pieces. It is an interesting commentary that this is done with only a single set of broach inserts, and only a single main fixture with a small auxiliary fixture.

The broaching machine is of single-ram vertical hydraulic type of rugged construction. The secret of being able to broach so wide a variety of pieces, economically, is found largely in the design of the fixture, which features the use of four removable hardened steel shoes bearing against the part to be broached.

So far, we have described instances of the application of broaching—either of holes or of external surfaces—for a multiplicity of different parts. The versatility of broaching is further exemplified in the ability to combine a number of operations on the same part, and the still further possibility of handling several such parts either of the same kind or of different design simultaneously on the same machine.

To cite but one example, consider the case of a manufacturer producing track links on which each of three surfaces had formerly been machined in separate setups. The broach manufacturer was called in to assist in stepping up production. As a result, five different parts were tooled on

FIG. 9. A single ram, vertical surface broaching machine, with but a single set of broach inserts and a single fixture with a small auxiliary, finish broaches 24 different trip dogs and 13 different torque strips.

FIG. 10. Close up of fixture, showing a dog in the clamped position after the broaching operation has been completed.

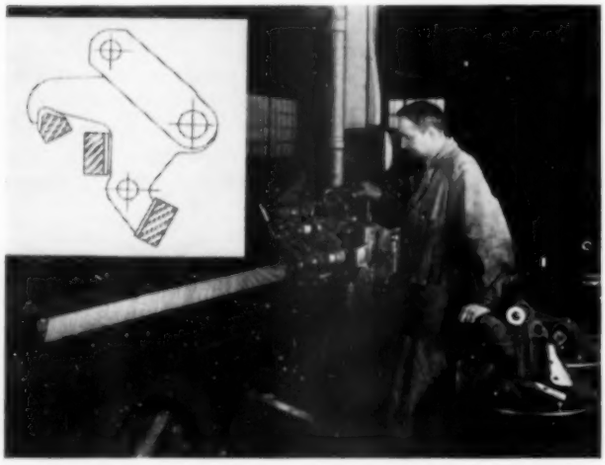
FIG. 11. Same as Fig. 10, except that part is unclamped. Note the accessibility of the screws for changing clamp inserts and locating stops.

FIG. 12. A completed trip dog. The odd shapes, on many of these parts, require a wide adaptability of fixture design to accommodate all of the many different types.

the one machine, using a single set of three broaches. And the three surfaces of each track link are machined simultaneously!

This was accomplished by designing a single fixture for holding two parts—one right and one left—at a time, and broaching the three surfaces simultaneously. As illustrated in Fig. 13, the radius at one end is broached to $^{21}/_{32}$" with a stock removal of $^{5}/_{16}$". The flat surfaces at the inside center and on the outer end are finished $2^{1}/_{8}$" wide with a stock removal of $^{5}/_{16}$" from each surface. Not only was production increased, and size held within specified limits and with satisfactory finish, but, tool life exceeded all expectations! On SAE 3140 forgings, about 1000 pieces per grind are produced by the radius broach, and 3000 pieces per grind by each of the flat broaches. On SAE 1045, they get about 3000 pieces per grind on each of the three broaches.

FIG. 13. The radius at the left of the part (shown in inset) is 21/32" and 5/16" stock is removed by the broach. The surfaces in the middle and at lower right are each 2⅛" wide, with 5/16" removed from each surface. Note the simple yet versatile fixture and the size of the workpieces, in the barrel, as compared to the operator's hand.



The secret of such flexibility stems from skillful advance planning. First step in the process is to group all of the parts which are reasonably similar in their machining requirements. To make this most effective, it is usually desirable—where practically possible—to select a family of parts capable of being broached with a single set of broaching tools. While such grouping is not always feasible, it is possible, under the circumstances, to achieve maximum economy even where it is necessary to provide several different broaching tools and a number of different fixtures. Part of this economy comes from the ability to utilize just one broaching machine and to centralize a variety of operations at a single station, taking advantage of the special skill of a trained operator familiar with the job.

In discussing the versatility of broaching, we must not overlook the point that it also widens the scope of metal removal by its ability to handle parts which require special formations not readily or economically produced by any other means. There are occasions where cost and economy are of little consequence because the important thing is to find a simple way of machining an intricate piece of work. Wherever the broach can be applied, it will offer the most simple and most economical solution.

A comprehensive handbook dealing with the art of broaching in all its ramifications has been published by the Broaching Tool Institute, 75 Trinity Place, New York 6, and is available upon request. If you have a small-lot machining problem for which broaching may offer a solution, the Broaching Tool Institute will be glad to give advice and recommendations.

Broaching Blind Holes

An ingenious and effective use of broaching where, at first glance, its applicability borders on the "impossible" is illustrated in an installation recently completed by a member company of the Broaching Institute. The job is the production of helical splines in a blind hole in a transmission part, the design being such that the tool cannot pass through the work.

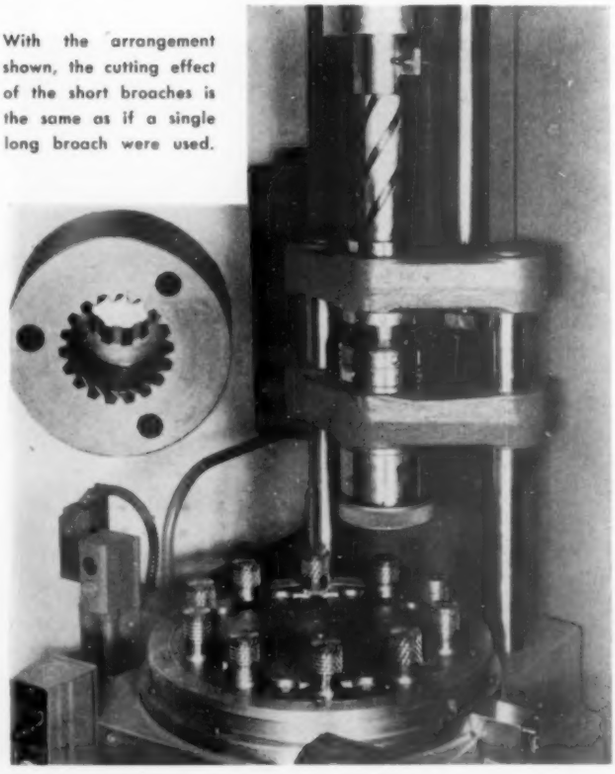
Theoretically, therefore, broaching could not be used. However, the use of broaching, with its combined precision and high output, was made possible by simply undercutting a recess, for broach clearance, beyond the section of the part to be splined.

Ten short broaches—each with five sets of cutting teeth—are used in place of a single long tool. Instead of actuating the broaches, however, the part is held in the moving ram head, the latter being equipped with a master lead bar actuated by the ram movement. The broaches are mounted on a hydraulically actuated indexing table.

Machine cycle is completely automatic, the operator merely loading the part and pushing a button. The ram moves down, pushing the part over the first broach, then returns and stops. The table automatically indexes to the next station, and the cycle repeats automatically until the part is finished, when the machine stops for re-loading.

The part, of course, is stripped off the broach on each return stroke. Obviously, also, broaches must be exactly spaced and located so that the teeth of the different broaches will track each other as they progressively cut the spline to finished size and shape.

With the arrangement shown, the cutting effect of the short broaches is the same as if a single long broach were used.



By Kermit T. Kuck

Shape Turning on a Lathe*

Intricate Shapes, Including Ovals and Irregular Contours, Formed with Exact Duplication on Automatic Form Turning Machine

This article might just as well have been labeled "Keeping Up With Our Customers," for their repeated calls for help in solving intricate form-turning problems have been the spurs behind most of the developments that Monarch has made in the form-turning field. No matter in what shape a contour-turning job may be, we find ourselves regularly elected to do something about it. Often, we have been approached for a solution to a combination of requirements which, in turn, has resulted in the development of special attachments, or even a special machine.

Kermit T. Kuck **was graduated from Ohio State University with degree B.S. in Mechanical Engineering. Joining the Monarch Machine Tool Company in 1935, he successively served in the factory and in the engineering departments; as Project Engineer in the Chicago office, and as District Manager of the New York-New Jersey area. He was appointed Chief Engineer of the company in 1943. He is a member of the A.S.T.E. and of the Engineers' Club, Dayton, Ohio.**

Back in the early 20's, turning a form on a lathe was a more or less improvised procedure. By this, is meant that the operator simply manipulated the longitudinal and transverse feeds of his lathe to generate the required contour. Naturally, this did not result in accurate work. To attain greater accuracy, machining templates were frequently devised for the guidance of the operator. In other cases, where large radii or complicated forms were required, they were usually obtained by using form tools ground to the exact dimensions of the required contour.

Any way you looked at it, the making of molds, hobs and dies having contours was a highly-specialized trade. In most cases, the roughing operations were split up so that part of the work was done on a lathe, other parts on a profiling machine, or by means of such other power-driven tools as made it possible to help accomplish the end result of removing as much metal approximating the contour as possible.

Finishing the work required skilled men, able to do very intricate machining by the application of hand tools in the processes of chipping, filing, grinding and stoning. Every job represented this time-consuming procedure. More important still, even the relatively simple jobs defied precise duplication, regardless of the fact that the work was performed by highly skilled men. Furthermore, the time involved in doing these operations was very great, and the cost of making the dies or molds in some cases reached exorbitant figures.

Given the time, a skilled man can do a good job, but neither he nor any other operator depending on hand work can duplicate exactly two dies or molds. The less skilled the man is, the greater the departure in the small but important details from one piece of work to another.

These machining problems also imposed irksome handicaps on artists charged with the purely creative aspects of product design. Take a perfume bottle, for example. Not only must the bottle be sufficiently distinctive to suggest its fifty-dollar-an-ounce contents, it must also be made to such accurate dimensions that, when filled, the level of the liquid will come just so high in the neck of the flask, no higher and no lower.

Many a first mold for such a bottle, however carefully it has been designed by the artist and executed by the skilled metal craftsman, has had to be reworked to satisfy this measure of capacity. If the necessary changes to reach the desired capacity could be effected with but little re-machining work, well and good! What all too frequently has happened, of course, is that the whole mold has had to be gone over. This has not only meant more time and trouble for even the most skilled workman, but it has also introduced a 50-50 chance that the balance symmetry and perfection of detail, which may have been achieved originally, is upset beyond recovery.

All these things finally led to the development of an automatic form-turning machine, with which it is possible to turn or bore a workpiece of circular cross section to any pre-determined longitudinal contour from a thin sheet-metal template.

Production executives all over the world were immediately and keeply interested in the announcement of this new machine—the Monarch-Keller Form-Turning Machine—and it is no exaggeration to suggest that this idea of automatic

**Adapted from a paper, by the author, at the A.S.T.E. New Era Exposition.*

The Monarch Shapemaster lathe.

Die, broach and punch for making plastic ash tray base.

contour turning revolutionized the processes for the manufacture of molds and dies.

In actual operation, the tool is guided in the work by means of an electric tracer, which engages a thin sheet-metal template the exact cross section of the workpiece. Alternate longitudinal and cross feeds are secured from magnet clutches driving the carriage and cross slide of the lathe. The pressure of the tracer against the sheet-metal template is only a few ounces, thereby eliminating the necessity of using a hardened and ground template.

The design of the machine is so arranged that, in addition to the automatic electric form-turning controls, all the features of the standard toolroom lathe are retained. These desirable features have made the machine a real success, and a large number of these machines are now in use in many countries and operating successfully in a wide variety of industries. Production over other methods is increased by as much as 400 to 500 per cent. The broader application to which this equipment could be applied was not fully taken advantage of until the outbreak of the war, when large numbers of them, running twenty-four hours a day, were put on war production jobs turning out accurate contour work.

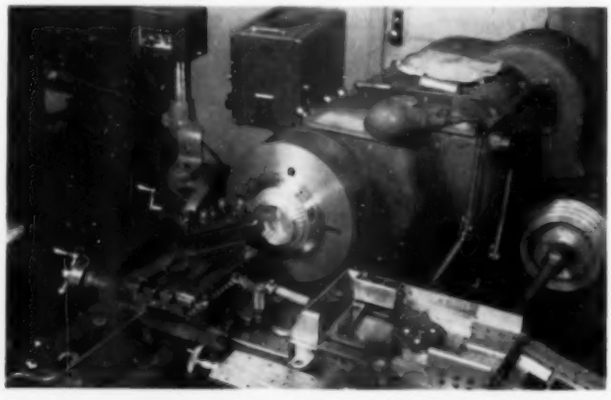
While this machine permits the accurate machining of such things as glass bottle molds, can-forming dies, punches, spinning chucks, and similar products, we were aware that designers would not be content with contours of round cross sections only.

When we were first approached by a mold shop for equipment to machine an oval mold, we had nothing available to do the work, and our customer had to turn down a job he would very much like to process. This request was followed by so many others of similar nature that we kept after the problem until a piece of equipment was designed which would take care of at least a limited amount of this kind of work.

An oval chuck, whereby it was possible to turn elipses in conjunction with other contours, was developed. This equipment was especially adaptable to the machining of molds for glass baking dishes, for oval-shaped bottles and for making punches and dies for tin cans. The stamping people were particularly interested in this type of equipment for making dies and punches for turning out such articles as oval dish pans, hospital accessories, and other utensils. The oval chuck is also used for making dies for light reflectors.

These developments still do not meet all the requirements of the glass industry, for the reason that designers desired cross-sectional contours in their molds and shapes other than simply round or oval. Again, in undertaking to satisfy our customers' requirements, we wound up by developing several specially-built machines for machining work having a surface varying in distance transversely from its axis of rotation. A cam-driven oscillating tool slide was used in the design, so that as the spindle and work revolved the tool was brought into play, and the shape of the cam duplicated on the work. An application of this sort, we found, was ideally suited for boring pump bodies having rotors other than round, flue cleaners and other products with irregular shapes. In the glass industry, this equipment was adapted for the boring of molds for square glass fruit jars.

The advantages of the square jars are, of course, obvious when considering the space requirements in packing and shipping, and it is largely because of the development of equipment to bore molds for square shapes efficiently and at low cost that the square jars are today being used in such large quantities. The same idea has since been adopted by manufacturers of milk bottles and of containers for other items.



Above and below, fluting inside of steel die for plastic ash tray base.

Fluting the oval die for plastic ash tray base.

Fluting the oval broach for multiple cavity plastic ash tray base.

As the demand for glass jars increased and molds were required for various sizes of jars, our customers required additional features from their equipment which were not incorporated in past designs. To increase production of molds, it was necessary to design equipment which would permit the boring of any size mold of similar cross-sectional contour by merely changing the setting of the machine, rather than changing cams. It was, therefore, necessary to incorporate a compensating mechanism adapted to vary the stroke of the cutting tool from the stroke imparted by the cam to its follower, so that the same cam could be used on either smaller or larger diameter work, and at the same time retain the original contour.

This feature was incorporated in what we called our centrode device. Used in conjunction with the automatic form-turning controls, it made it possible to machine contours with limited sizes of radii in a geometrical pattern. Ovals, triangles, squares, hexagons, octagons, and any shapes up to sixteen sides having a maximum radius variation of two inches could be machined either flat, concave or convex.

Even with all of these developments, we received numerous requests for means of attaining still greater flexibility in the turning of cross-sectional shapes on changing contours, such as being able to bore a mold for a flat bottle and automatically change the contour as would be necessary when blending the flat portion of the body to the round neck section. The mechanism to perform such operations, added to our previous designs, culminated into the most universal turning machine ever conceived, namely the Monarch Shapemaster.

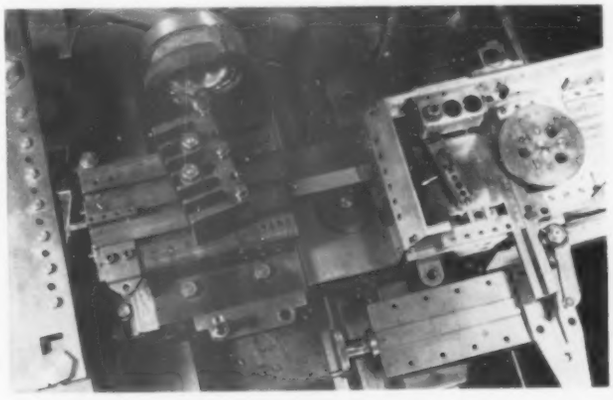
It is literally impossible to calculate the number of different shapes and contours which can now be machined to extreme accuracies, regardless of whether the general cross-sectional outline is round, oval, square or any figure which permits the entry of the tool into the cut. Today it is possible for us to turn an oval cross-section with flutes on the contour of the oval and, by an automatic stroke-changing device, to change automatically from an oval to a circular section, carrying the flutes on all sections or gradually eliminating them as desired. This setup is possibly the most complicated, and from there on it is possible to machine molds with as many as five hundred flutes either flat, convex or concave, each flute being an exact duplicate of the other.

The Shapemaster is essentially a mechanism consisting of three elements. One controls the shape cut, another regulates the rate of repetition of the shape on any given circumference, and a third controls a contour on successive diameters.

The master record incorporated in the machine's mechanism usually records only a single element or unit of the desired design or pattern. In a fluted dish mold, for example, the master record will represent a curvature of only a single flute. Repetition of the shape to be cut is determined by the geared relationship of the record and the spindle. The longitudinal contour is controlled by the automatic form-turning controls operating from a thin sheet-metal template, while the stroke-changing mechanism, which automatically changes the stroke of the tool as it passes from one diameter to another, is incorporated in the shaping device. The design has further incorporated in it the necessary mechanism for machining the records from a master template, making it possible to machine a mold completely from a drawing.

The exact quantity duplication of molds, punches and dies now becomes a relatively-simple matter, and hundreds of combinations and variations of designs are easily created from a single master record. While the great usefulness of this machine to the glass and plastics industries is quite obvious, its versatility adapts it to a very wide range of production work which requires the machining of odd shapes.

Fluting punch for plastic ash tray base.
Diamond fluting of mold for glass dish.

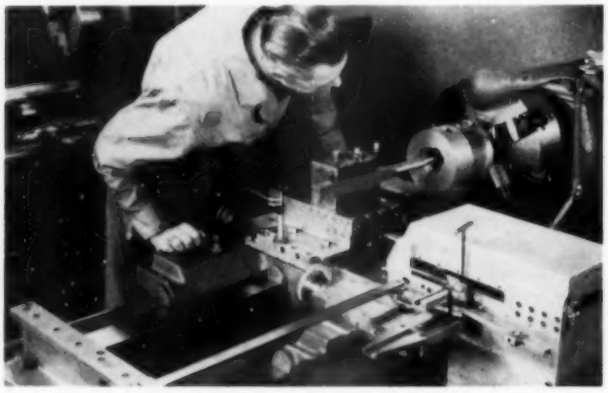


Fluting inside of mold for glass ash tray.
Straight fluting of mold for glass dish.

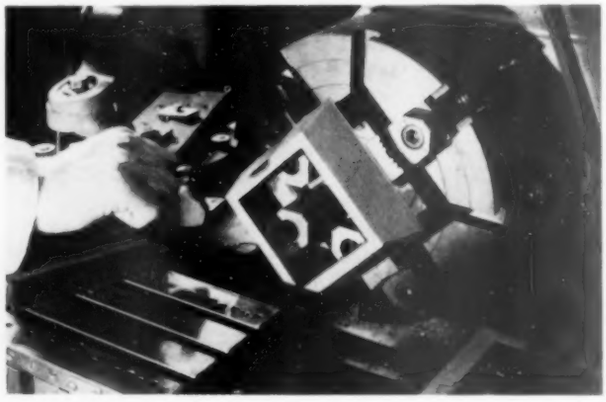
In another development, which should be of interest particularly to the plastics people, is a device which can be applied to mold-making machines to compensate for material shrinkage on thread forms. Plastic die molding thread forms must always compensate for shrinkage of the material to be molded, and often a considerable train of gears is required to modify a lathe or thread miller, so that threads can be cut in the die with proper variation in lead to compensate for this shrinkage. With this device the lead of the thread can be easily modified up to as high as .030" variation per inch, by means of accurate dial setting without disturbing any gearing in the machine itself.

Now then, what do all these developments mean to our customers in dollars and cents? Take, for example, a glass knob which is produced in large quantities by a leading manufacturer. The production requirements are such that, in order to keep their molds in first-class condition, it is necessary to replace one mold each week. The plant is operating 36 hours a week, which is the exact time required by the mold maker to make a replacement mold. A year's production would require 52 molds, and it would take exactly 52 weeks to make the molds by their present methods. After investigating the Monarch Shapemaster and actually machining a duplicate mold on this machine, it was found that the machining time per mold was 2¾ hours, permitting them to machine a year's production in 4 weeks —13 times faster than possible by past methods!

Boring a two-piece mold for a popular carbonated beverage bottle.



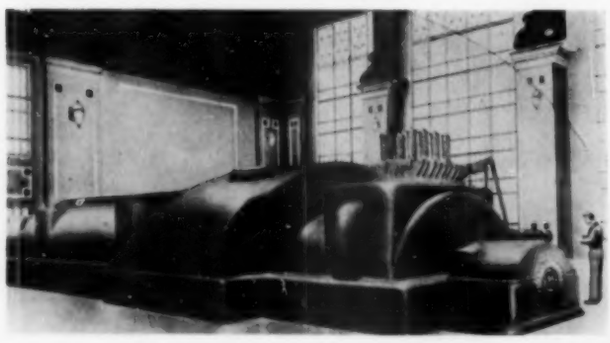
Turning a square piece. The companion operation would be the boring of a square hole in the same piece.



Huge Turbine Generator in the Making

Among "Tools of Tomorrow," since it is in the making and scheduled for 1947 delivery, a giant turbine generator, by the Turbine Division of General Electric Company, will be largest of its kind in the world. The completed unit, of which an artist's conception is shown, will be 77 ft. long, 17 ft. wide and 11 ft. high. It is rated at 100,000 kw maximum, and will operate at inlet conditions of 1250 psi and 1000 degrees F. at 3600 rpm. It will be used at the Essex Station of the Public Service Electric and Gas Company of New Jersey.

There are nineteen high-pressure stages and five stages in the double-flow, low-pressure side. The last-stage wheel carries a new 23 inch long bucket of variable angle double-warped airfoil section. Maximum tip speed of the bucket, 1390 ft. per second. It will have provision for removal of moisture, also, a newly developed hydraulic and oiling system.



The generator, hydrogen cooled, is the largest 3600 rpm machine ever constructed, and is rated at 95,000 kw, 0.85 power factor and 0.85 short-circuit ratio at 15 psi gage hydrogen pressure.

Feed Rate Calculator

A novel "Feed and Speed Calculator," based on the slide rule principle, is being made available for calculating the proper feed per tooth per revolution for all types of carbide milling cutters. The device, which includes a table of decimal equivalents, also shows the suggested rate of speed for machining many different kinds of materials to rough and finished states.

The reverse side shows the relation of revolutions per minute on the cutter head, and the surface speed in feet per minute, to the diameter of the work. The calculator can be obtained from *Wendt-Sonis Co.*, Hannibal, Mo., makers of standard carbide tipped cutting tools.

By C. E. J. Brickner

The Tool Engineer's Place in Industry

Coordination of Product and Tool Design Assures Good Tooling and Low Manufacturing Costs

Being a specialist in the design and application of tools, jigs, fixtures, and other manufacturing equipment, the tool engineer is an important factor in determining the cost of the end product. If his tooling is good and his methods efficient, the cost is low; if they are not, the converse is true.

C. E. J. Brickner **learned toolmaking at the Westinghouse Trades Training School and worked up through tool designing, time study, plant planning and layout engineering. In 1939, he was assigned to the Headquarters Equipment Dep't as Equipment Engineer, a position of considerable responsibility in the Westinghouse organization. During the war, he was active in "tooling" for atomic bombs, electric torpedoes, ship propulsion equipment and radar. Right now, he is busy reconverting the plants he helped to convert. Active in the A.S.T.E. since joining in 1939, he is immediate past Chairman of Pittsburgh Chapter.**

When completing the design of new electrical equipment, the development engineer should cooperate with the tool engineer to insure that the finished design will produce the most efficient apparatus and will not develop manufacturing difficulties which cannot be surmounted with available manufacturing equipment. Careful study should always be made by the design engineer, tool engineer, and manufacturing sections to eliminate any possibilities of impractical apparatus designing.

After a complete design has been agreed upon, the tool engineer should study the existing facilities to determine if it can be produced with equipment available, and at that time he should plan to acquire any new machine tools, dies, jigs, fixtures or gages necessary to meet the required production, in line with the forecasted activity of the apparatus

FIG. 2. A punch press feeder in operation.

FIG. 3. The same feeder opened for die removal.

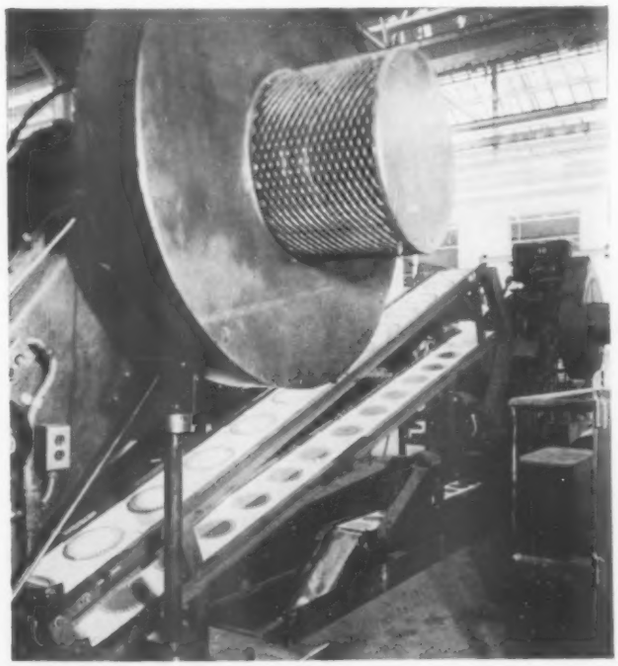
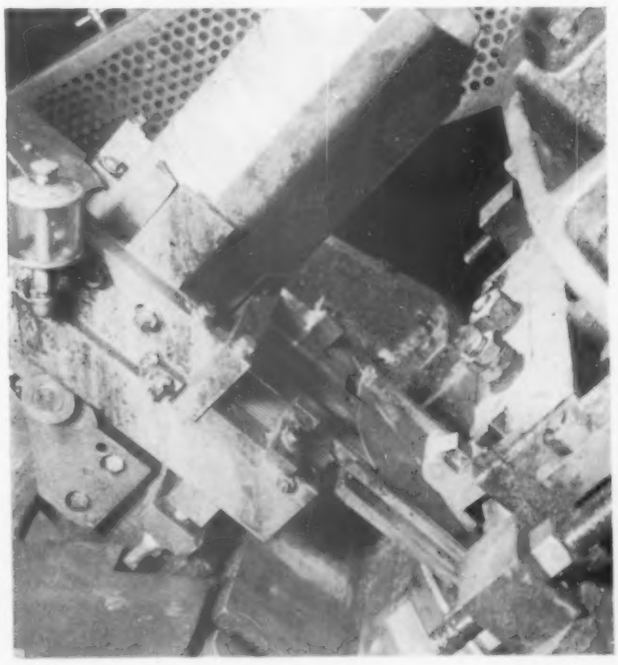


FIG. 1. The tool engineer is not only concerned with tooling, but with materials handling as well. Here, a conveyor system carries rotor punchings from a press and stacks them in piles.



as supplied by the Sales Department. In planning jigs, fixtures and gages, the tool engineer should keep in mind that each operation performed should start from the same focal point on casting or other work to keep down the variation caused by an accumulation of tolerances which may be permitted in the manufacture of our product.

The tool engineer should give careful study to the latest developments as to type of cutting material and other characteristics of cutting tools, so that they can be ordered to gain the advantage of the numerous types of carbides and high speed steel cutting procedures.

The tool engineer should also determine the type of machine to be used in his manufacturing procedure; if the apparatus has large quantity production, in lots of 1000 or more, it might be practical to manufacture on an automatic screw machine, in which case he should study the tooling so that the necessary cams, circular tools, and dovetail tools can be planned for the product. If the activity would not justify an automatic screw machine, it is possible that a number of standard setups could be made on a turret lathe, which would also give him a good manufacturing cost.

In order to illustrate the details covering the activities of a tool engineer, a study was made of the lamination manufacture of the one to three horsepower motor. Punchings are made from sheets 0.017" thick, requiring 59 punchings to build one inch of stator or rotor core. In the average rotor or stator there are approximately 420 individual punchings used. With this number in each motor, multiplied by the thousands of motors made per month, it is obvious that the manufacturing problem is one of considerable magnitude.

There are several conventional methods for producing these punchings, and the method selected should be determined after studying the frame sizes and the production requirements as estimated by the Sales Department. In arranging the manufacturing layout for these motors, the tool engineer sets up a blanking die on an upright punch press with a roller feed, making four $8\frac{3}{4}$" blanks per stroke. These blanks were nested so as to get the greatest material economy from the sheet size and are punched through the die onto a belt conveyor, which conveys them to a sorter, where defective blanks are removed and the punchings automatically stacked. They are then moved to a convenient place adjacent to the stator punch presses.

These punchings are then automatically fed by magazine feeder to an inclined punch press, operating at 65 strokes per minute. A compound die is used in this operation, and the completed stator punching is ejected from the punch part of the die onto a chute to the top belt of an inclined double belt conveyor, as shown in Fig. 1. This belt conveyor carries the punching to a second chute which deposits it on a horizontal belt conveyor. The horizontal conveyor delivers it to an automatic stacker where it is lined up by

FIG. 4. A variety of punchings can be made on the same press by varying the die design.

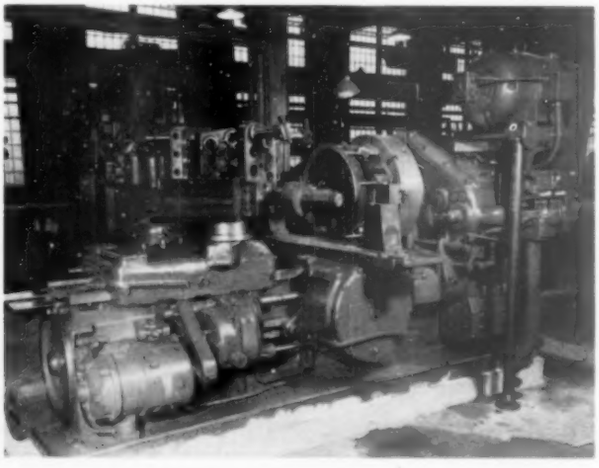
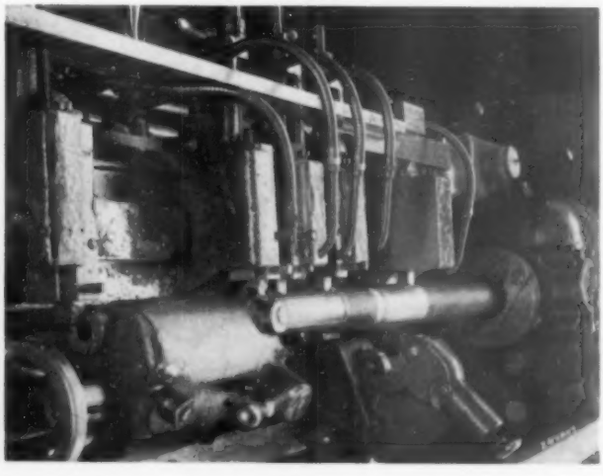


FIG. 6. Turret lathe operation completes the turning, facing and boring, complete, of a motor bracket which previously was made in three machines—two boring mills, and one lathe.

FIG. 5. A multiple tooling saves critical machine tools and lowers production costs.

FIG. 7. This setup, using multiple cutting, lowered costs and gave a uniform quality.



an external keyway ready for weighing and riveting.

The center portion of the blank is ejected from the bottom, or die part, of the compound die by means of a spring stripper; it drops to a chute which delivers it to the bottom belt of the double belt conveyor. This punching is then conveyed to a three-latch feeding chute which is cam-timed from an inclined punch press. The tool engineer has so arranged the speed of the presses that the press runs at a slightly higher speed than the first press, or 73 strokes per minute. The center portion of the blank is automatically fed into a trimming die. The trimming die cuts the "petals" from the blank and produces a round disc of approximately $5\frac{7}{8}$" in diameter. This disc is punched through the die and does down a chute to a belt conveyor running beneath the floor. It is then delivered on this conveyor to an automatic stacker. The discs are taken from the stacker to a convenient storage location adjacent to the rotor press.

The rotor blanks are taken from storage or directly from the automatic stacker, and loaded into the feeders of the rotor punch presses. These punch presses are inclined and run at 75 strokes per minute. The blanks are automatically fed into the piercing die, which makes a complete rotor punching. (See Fig. 2.) The punching is stripped from the top or punch part of the die, and falls into a chute to a belt conveyor, which carries it to an automatic stacker. Here it is stacked on a rod in correct alignment with the shaft keyway. Automatic feeders were added. (Fig. 2 shows a feeder in operating position; Fig. 3 shows it open for die removal.)

Fig. 4 shows some of the varied line of laminations that are now being produced by the setup previously described, which greatly reduced manufacturing costs through the efforts of the tool engineer.

When high production justifies the expenditure to completely tool a product, a special machine is purchased. However, in cases where the activity does not justify a special piece of machinery, a fixture may be made to machine multiples as shown in Fig. 5, which shows a fixture holding four shafts and milling four slots at one travel of the table.

Fig. 6 shows a lathe completing the operation of turning, facing, finishing rabbit-fit and boring complete, of a motor bracket which previously was machined in three machines, consisting of two operations on boring mills and one operation on a lathe. This rearrangement was made at the suggestion of a tool engineer. Steps were taken to contact the various manufacturers of equipment to obtain their recommendation of a machine which could manufacture the motor bracket complete in one chucking and arranging operation to follow in proper sequence. This was accomplished on an automatic turret lathe with a cross slide. Carbide tools were also added, which made additional savings.

Fig. 7 shows a semi-automatic lathe rough machining motor shafts with tools mounted on carriage to machine each step on the shaft to shorten feed and break up the cut. Roller steady rests are used to support shaft and maintain size.

In summarizing the future activities of the tool engineer, it is apparent that more ingenuity and clear thinking will be required to reconvert from wartime production to our normal postwar products, and much will depend upon the ability of the design engineers, tool engineers, and manufacturing organizations as to the success attained and progress made by any manufacturing company in the postwar years.

Due to the great progress made in materials, manufacturing procedures, and accuracy of machining and gages for measuring the product in the last few war years, it behooves all manufacturing organizations to take full advantage of all phases of this progress to produce a better product at a lower cost.

By George W. Sharp

The Human Element and the Point of the Tool

The Right Tool, with Correct Rakes and Cutting Edges, Makes Profits for Industry

The "human element" is a very important factor in the efficient performance of cutting tools. The engineer's attitude and his willingness to be shown—his open-mindedness—is what this article particularly deals with, not with the machine operator's attitude. That, however, is another important human element bearing on the point of the tool.

New ideas, when first tried, are quite often failures—at least, they may not be entirely successful. The steamboat, the automobile, and the radio, among countless inventions, were not tremendous initial successes, but, through the faith of men with vision, who had ability to realize potentials, their practicalities were eventually realized and, as a result, new industries evolved.

Now, of course, the change of a rake angle is not going to start a new industry, but the thought is the same. When, after the thought has been conceived, it usually has merit or it will not be tried even once. And in this country, when something gets tried, and shows promise of merit, it will eventually be perfected. In line with this vein of thought concerning new ideas, we cannot overlook the fact that, generally, humans resist the interruption of an accepted routine and prefer to cherish an illusion, for romantic reasons or otherwise, rather than be faced with the prosaic facts.

George W. Sharp **learned his trade "from the ground up," starting by sweeping floors in a family-owned machine shop. He then attended Pennsylvania State and Newark College of Engineering (evenings) while gaining experience in machine and tool design. After several years with Wright Aeronautical Corp'n, in production and engineering, he joined Kennametal, Inc., as sales and service representative.**

Naturally, the foregoing doesn't apply to tool engineers who, lacking temperament (?) and living in a world of reality, prefer stark truth to fantasy.

There are perhaps as many opinions, among tool men, regarding tool applications as there are types of tool material (such as 18-4-1 or the various grades of carbide) and perhaps the principal reason is that the "conclusive data" necessary to overcome the many variables has never been and never can be compiled. Conclusive data is not arrived at by one or two runs, yet, one cannot go on making test runs indefinitely and one cannot test every material on the market. This article is not a proposal, therefore, to develop a method of testing; rather, it may be construed as an appeal for common sense in the application of tool material.

Surprisingly many people think that there are Gremlins in machine shops, while many others take the attitude that the manufacturer of a certain material does not know how to use his own product. It is equally surprising that these same people claim marvelous results from mis-application; although, the time usually comes when it becomes necessary to put them onto the right track. Even then they resist.

The "Gremlins" referred to cause a production job that has been running along nicely over a long period of time to suddenly go wrong. And by the time it is running smoothly again, anything might have happened from change of side rake to a complete change of everything connected with the set-up. It seems incredible, at times, how far these changes can go, but usually, there is a simple explanation for this—namely, that the actual difficulty hasn't been eliminated. It is not always the simplest thing to diagnose the trouble, therefore, complexities that may be encountered indicate the necessity for a systematic method of checking the factors by process of elimination. Further, it can be readily seen that, to have efficient cutting tools, a program must be established to control material and tool geometry, and to coordinate methods.

A few illustrations can best expose various so-called mysteries of cutting tool behavior. One large manufacturer had always had cutting tool trouble but had never planned a program covering proper handling. It had not been considered necessary. Strangely enough, the concern didn't mind buying three lathes for $100,000, but the thought of investing a mere $1,000 for a carbide tool grinder, to be used for grinding the tools of the entire shop, terrified them. It would seem obvious, however, that the point of the tool makes or cuts profits and that the proper grinding of the tool is certainly deserving of such a nominal investment.

This manufacturer phoned our office and complained that a shipment of tools, which we had furnished, would not stand up. We had supplied him with 200 left-hand and 200 right-hand single point lathe tools of the same style. We were informed that the left-hand tools were no good but the right-hand tools were okay. Arrived at the plant, our service engineer went to the machine, examined the tools and stood by while the operator made a number of cuts, using several tools. The tools traveled about an inch or so and burned up, one after another! The service engineer then requested that they give him the tools that had burned the worst, and he took them to the grinding department and ground them himself.

Returning to the machine, one tool was put to work and, lo and behold, it worked perfectly! Back at the grinding department it was found that a new man had been placed on grinding the left-hand tools. Further investigation revealed that the table of the grinding machine, which this man was using, was grooved from use and, though the table was set for 6° primary clearance, the tools had been ground practically at 0°.

This fault was not easy to detect because, in good carbide grinding practice, it is usual to grind the secondary clearance to 8° and finish grinding the primary clearance to 6°. Furthermore, 6° primary is only from $\frac{1}{32}$" to $\frac{1}{16}$" in depth and visual inspection will not ordinarily reveal the inaccuracy to the grind. This instance is explained in detail to bring out that the material would have been condemned, and possibly forever, if we had not gotten there immediately to catch the actual reason for the trouble, simple as it may now seem.

The usual trouble, however, is not nearly as complex. Usually, the tools just won't work, but someone who knows the fundamentals—or better yet, someone who has taken the trouble to learn the fundamentals—prepares the tools and they perform quite satisfactorily. However, the complainers cannot seem to understand why because they haven't taken the trouble to understand the importance of the point of the tool.

A typical instance, which has been duplicated many times and one which occurred in a large corporation, deals with opinionation. In this instance, the operator discovered a different marking on an otherwise standard tool and immediately jumped to the conclusion that he had been given an imitation. Consequently, the tool was beaten before it ever went into the machine. The recommended antidote is to pull up a chair alongside the machine and sit there until the usual number of pieces have been produced.

Another example of opinionation is found in the fellow who insists upon the wrong grade of carbide—for instance a soft roughing grade for finishing, or vice versa. The recommended procedure, to get the truth across to this type of individual is to prepare it properly. Give him the *correct* grade of tool as if it were what he requested, then, when he is all through telling you how well that tool performs, and how you should listen to him, you can tell him the truth—especially now that the manpower shortage is apparently over.

In another large concern, the lack of tool men who, specifically, had cutting tools as their responsibility, kindled the curiosity of a service engineer, who asked a responsible executive what they did about trouble. He said that they never had trouble, and the reply was: "Then, you do not set your sights very high and you are not working with what is new, because it is not natural to design all your tools on a drawing board and never have trouble when they are put to work."

In direct contrast, there is another concern that is always in trouble and the reason is that they are always using every new thing; also, they are out to get the utmost every time. This attitude is certainly more desirable than the complacent attitude of the company previously mentioned. For various reasons, however, this attitude must be tempered. The main reason is to protect the organization from suffering with "somebody's baby" because, oftentimes, the job runs out before the "bugs" are ironed out. Thus, the benefits are lost. However, any "on the ball" manufacturer can hardly afford to overlook any new development relevant to the processing of material.

At present, the cutting tools are out in front with machine tools running behind, therefore, knowledge of the point of the tool should be an equally important part of the repertoire of the methods department.

By Phil Glanzer

Mass Spectrometer for Industry

Quality Control Speeded and Correct Analysis Assured by Means of Hyper-Sensitive Instrument.

Modern refineries and chemical plants require accurate control of all materials and processes. Many products are made continuously—thus, if an error creeps in, thousands of gallons or hundreds of tons of material will be spoiled if correction is not made speedily. If, for example, the product happens to be high octane aviation gasoline or synthetic-rubber constituents, the error might become a national calamity.

Production of high-octane gasoline, butadiene, or styrene involves precise critical processes and, laboratory-accurate on a huge scale, they need controls that are both exact and rapid. After a great deal of experiment and research, engineers have developed a new control mechanism—the mass spectrometer—that fulfills the requirements. Previously, chemical tests in an oil refinery have been laborious and have required hours to complete. The new device thoroughly checks operation in a matter of minutes and requires only one or two technicians.

The mass spectrometer has long been used in laboratories, particularly for exploring the field of nuclear physics. It determines, both qualitatively and quantitatively, the constituents of a gas. With substances that are alike chemically and differ only slightly in weight, chemical analyses are extremely difficult.

The mass spectrometer uses only a small quantity of the gas—it need be only a thimbleful—and ionizes it by impact of electrons from a hot filament in an evacuated tube. The stream of charged molecules is drawn along the tube into a strong magnetic field, where it is bent into an arc-shaped path. The heavier the ion, the larger the radius of curvature of its path. As a result, different molecules emerge from the field at various locations—but all of the same kind leave at one particular spot. Differently charged molecules are collected successively at an exit slit into a current that can be amplified and measured. In this way, constituents of any gas can be determined as to kind and proportion.

Built for use in refineries, chemical plants and similar locations, the mass spectrometer is a self-contained tool. No power supply other than 110 volts, 60 cycles is required. The instrument is extremely sensitive and can measure ion beams as small as one billionth of one microampere. (Average antenna current for the home radio is at least one microampere.) In other words, the mass spectrometer counts as few as 6,000 ions per second, which isn't many considering that about three billion billion electrons surge in and out of a 60-watt lamp each second. The device can readily detect, for example, the presence of one part of oxygen in 10,000 parts of nitrogen.

The mass spectrometer is expected to have many industrial uses. It may serve to check gases in protective-atmosphere furnaces, may check completeness of evacuation processes, or, it may detect presence of some undesirable constitutent in process gas.

A mass spectrometer—or electronic "chemist"—that will speed production of synthetic rubber has been developed by Dr. John A. Hipple, a 32-year-old Physicist. Dr. Hipple is shown with the instrument's key part, a curved glass tube fixed between the two poles of an electromagnet.

Operating panel of instrument, which will (a) trace stable isoptopes, (b) analyze minute traces of gas in a mixture, (c) make analysis where only a small sample of gas is available, and (d) give continued indication of changing composition during a process, such as the gas atmosphere in heat treating furnaces.

By H. W. Giesecke

The Process and Application of Lost Wax Casting

An Old Technique, Modernized, Permits Precision Casting of Hard Alloys

Lost wax casting—or precision casting—has been successfully applied to the forming of aircraft supercharger blades from a high melting point alloy, and offers possibilities for the manufacture of industrial parts from alloys which cannot be successfully shaped by the usual methods of machining and forging.

Essentially, the process consists of forming wax replicas or patterns of the desired parts. The wax patterns are surrounded by a concrete-like compound which hardens into a mold having refractory properties. After hardening, the mold is heated to melt out the wax, this step leaving a cavity in the mold having the size and shape of the desired metal parts. Molten metal is then poured into the cavity and, after solidification, the mold is broken away to release the cast parts. Since a new wax pattern is required for each part produced, the use of this process, in repetitive manufacture, requires that means for rapidly duplicating wax patterns be provided. Such wax patterns are formed by injection molding of wax in metal molds or dies.

Harold Giesecke **is a member of the New Products Div'n, Westinghouse Electric Corporation, and a licensed professional engineer. A graduate of Ohio State University, with an M.S. in Electrical Engineering from Columbia, he previously engaged in public utilities design and installatons, and on investigating electrical equipment for the Bell Telephone Laboratories.**

Modern use of the lost wax process began in the dental profession, about 50 years ago, when a technique was developed for producing cast gold replicas of tooth cavities. There is available a fund of knowledge, developed by the dentists, concerning suitable wax compounds, investment materials, and casting practices which is helpful to the student of industrial casting.

The jewelry trade learned the lost wax process from the dentists, and many jewelry manufacturing concerns have used lost wax casting in volume production of rings, brooches, and other types of jewelry. However, the techniques used by jewelry manufacturers have generally been held secret, especially with respect to the method of obtaining the wax patterns.

The casting of gold, silver, and other low melting point metals is accomplished by imbedding the wax patterns in a plaster of paris mixture which, after setting, is a suitable mold material for these metals. Smooth surfaces and fine detail reproduction are essential for jewelry, but high dimensional accuracy is of little moment; however, ornate designs are readily reproduced. During the war, many of the jewelry firms devoted their casting facilities to the production of small intricate brass, bronze, and aluminum parts required for electronic, ordnance, instrument, and aircraft assemblies. This experience has resulted in a general postwar effort by these firms to secure industrial business in these low melting point alloys.

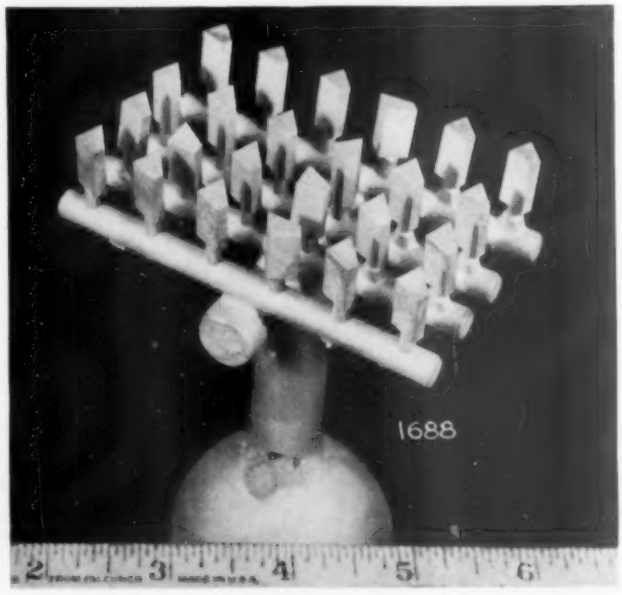
Industrial lost wax casting of ferrous and other high melting point alloys is a development that may be largely credited to Austenal Laboratories, Inc., of New York City.* This concern developed an alloy of cobalt, chromium, and molybdenum of high chemical stability for manufacture of dentures and the numerous structural parts used in orthopedic surgery. The alloy melts at approximately 2500 F and is marketed under the trade name Vitallium.** The process, developed about 10 years ago for casting this material, is now generally used for industrial lost wax casting of high melting point metals and is described in the following section. The essential difference in casting high melting point and low melting point alloys, by the lost wax process, is that the investment must be made of more refractory constituents for the high melting point metals. Plaster of paris is the basic ingredient of low temperature investments but cannot be used for ferrous alloys. High temperature investments are chiefly composed of silica powder with a liquid silicic binder. Such investments become sufficiently refractory after high temperature baking to withstand the pouring of metal at least as hot as 2500 F.

Lost wax casting produces parts that are reasonably

**The art of lost wax casting has also been highly developed by the Haynes-Stellite Company, Kokomo, Ind., a unit of Union Carbide and Carbon Corp'n.*—The Editors.

***Trade-mark of Austenal Laboratories, Inc.*

FIG. 1. Group of stellite circuit breaker trigger inserts—as cast.



smooth but they certainly do not have mirror surfaces. Surfaces may also be reasonably true but not to the extent that they can be used as precision bearing surfaces without a finishing operation. However, specified tolerances can be held to very close limits if the expense of very special handling of the pattern making and casting procedures can be borne; "close" in this case meaning plus or minus one mil (.001") as the ultimate.

While it is a specialized production tool that does a few things better than other available means, it is not a general cure-all for production difficulties. It is not, *per se*, a low cost method for mass production although it becomes economical under the conditions outlined below. No part that can be made on a punch press or a screw machine should ordinarily be considered for lost wax casting.

Neglecting pattern investment and cost of poured metal, the cost of casting by this method is practically a fixed sum per flask. Therefore, the cost per part is nearly equal to the "per flask" cost divided by the number of parts that can be gated together within a single flask. Small parts are therefore more likely to prove the more economical for lost wax casting.

It cannot be expected that fractional inch dimensions can be held closer than plus or minus one mil—in fact, it requires considerable care to hold such dimensions to plus or minus two mils. The accuracy of dimensions larger than one inch is correspondingly poorer, although excellent reproduction of surface details can be expected. Ornamental curlicues are splendidly reproduced, and curved and twisted shapes and thin edges, such as are found in turbine blades, are readily handled. Although there is no parting line in the investment it should be recalled that there is a parting line in the metal mold which affects the thickness of the wax patterns; however, the use of special die-flasks and good workmanship can reduce the parting line error to a small amount.

It is of interest, here, that the use of the heated refractory mold results in slow freezing of the metal casting. Using the mold at high temperature tends to reduce cold shuts and assists in obtaining complete penetration of mold crevices and corners. The baked mold material is slightly porous; therefore, the hot air present in the mold probably flows out through the mold material to some extent when the metal is poured.

There is an appreciable difference in foundry techniques when pouring into a hot mold as compared to pouring into ordinary cold sand molds. There are many considerations of progressive freezing, movement of molten metal through the gates to fill in behind the shrinking solidification zones, etc., in both methods of casting. Such problems, however, are handled differently in detail in the two methods. It is most helpful if the designer of any cast part will consult with the foundryman, so that finished designs will permit high quality economical castings.

Lost wax casting should be carefully considered in the following problems:

1. A part requiring metallurgical properties obtainable only in non-forgeable or non-machineable alloys. Example: Swaging dies for tungsten magnets (permanent).

2. Parts requiring complicated shaping but not requiring ultra-precise dimensional accuracy. Example: Gas turbine blades.

3. Tools and parts requiring high metallurgical properties, complicated shapes, and precise dimensions on only one or two easily ground or machined edges or surfaces. Example: Swaging dies and boring tools.

4. Parts of which only a few are required, which can be produced by lost wax casting with a pattern cost of a few hundred dollars and which, by other methods, would require dies or molds costing many times that amount. Example: Sample parts.

5. Small parts required, in quantity, of an alloy expensive to machine but which can be produced, without machining, by the lost wax method. Example: Small stainless steel pipe fittings.

6. Small intricate non-ferrous parts not castable in sand, which would require numerous expensive machining operations, but which are usable as cast by lost wax. Example: Instrument frames, gear sectors, business machine parts, etc.

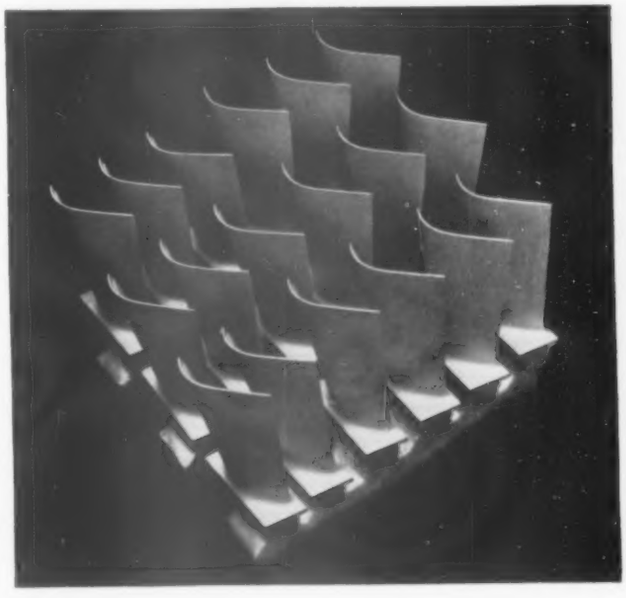
1. It forms parts, from alloys, which are not machineable or forgeable. 2. Provides ready method of making fairly accurate reproductions of many small metal parts. 3. Permits excellent reproduction of curved shapes, fine detail, and surface conditions. Particularly suited to parts having air foil, tear drop, and other such shapes often found in parts for handling gases and liquids. 4. The required equipment not excessively expensive.

5. Many complicated parts can be cast with sufficient precision to be completed with not more than one or two simple grinding or other finishing operations. 6. If holes are not too small (more than 0.1 inch) and have a reasonable length to diameter ratio (1.1 or less) they can be cast without coring. 7. Slow cooling produces castings with excellent reproduction of fine detail.

8. The wax pattern technique allows the use of assembled or built up patterns to produce very complicated parts. Ceramic cores can be used which can be accurately ground to required size and shape. 9. Relatively low tooling cost. 10. Sample parts can be produced in short time compared to other methods.

1. Precision limited to 2 to 5 mils per inch. 2. The large number of steps, in process and amount of manual effort required, prevent sufficient cost reduction for many applications. However, it is forecast that extensive labor saving methods will eventually be developed which will change this situation.

FIG. 2. Group of gas turbine blades as cast.



3. The process limited as to the size of molds and amount of metal poured. Ten pounds of metal may be poured in one mold, and while larger molds can be handled, difficulty increases rapidly with size. 4. Rigid process control required. 5. Threads, cast by this process, must be cleaned up afterward by chasing; however, satisfactory pipe threads have been cast.

Production of a finished casting requires a number of steps which are explained in the following paragraphs.

Master Pattern: A master pattern of the desired article is prepared, with shrinkage allowances if high accuracy is a consideration. High grade patterns require toolmaker skill in their preparation. Brass can be used as a pattern material although steel is preferred for its more general shop adaptability.

Metal Molds for Wax Injection: Molds for producing wax patterns may be machined from steel or brass in much the same manner as plastic molds are made. However, since the pressure and temperatures involved in molding wax are considerably lower than those required for plastics, sufficiently strong molds can be made from low melting alloys such as Wood's metal. The use of these molds reduces tooling time and cost.

The low melting alloy molds are formed by some modification of a technique long used by the jewelry trade. The master pattern is partially embedded in a suitable medium, such as modeling clay or plaster of paris, and the low melting alloy is cast or sprayed against the exposed portion, producing a mold segment which is a negative of the master pattern.

This process is repeated, exposing different areas of the master pattern and using the metal mold segments already cast to support the master pattern during the forming of subsequent sections. In this manner, a multi-part mold which completely surrounds the master pattern is produced. The pattern is removed from the mold, and gates for the entry of wax are cut along the parting lines of the mold segments.

Wax Pattern: A special wax compound, selected for hardness, low shrinkage and melting point, is injected into the metal mold. The wax must burn without leaving an ash. Increased accuracy may be obtained by lowering the temperature at which the wax is injected and increasing the injection pressure. This reduces the shrinkage of the wax pattern during cooling. Pressure is limited by the strength of the metal mold, and molds made of steel, instead of bismuth alloy, give longer life at high injection pressure.

Wax Pattern Assembly: A suitable number of wax patterns are assembled with preformed wax gate, sprues, and runners to make an assembled pattern of correct size for the standard refractory mold. This assembly is accomplished very simply by fusing the wax parts together with heated tools. A mass production technique is being developed in which the various wax parts lock together by friction at preformed joints, allowing very rapid assembly.

Pre-Coat: (This step is not always employed.) The wax assembly is dipped in a mixture of very finely powdered silica in a liquid siliceous binder. This pre-coat hardens to solid silica on drying. Since the surface of the pre-coat next to the pattern is composed of extremely fine material, a mold is obtained which has essentially the same surface smoothness as the wax pattern.

Investment: The pre-coated wax assembly is now placed in a metal flask and the flask is filled with the wet investment mixture. This material is a grade of silica which may be coarser than that used in the pre-coat mixed with a similar liquid binder. The flasks are vibrated to remove air and to settle the investment around the patterns. The investment is air dried to sufficient hardness to hold its shape, then inverted over a steam table to melt out as much of the wax assembly as possible.

Baking: The air dried investment is oven baked to a red heat to thoroughly dry and harden the silica mold. Remaining traces of wax are burned out during this baking.

Pouring: The metal charge is melted in a special electric arc furnace. The mold is placed upside down on top of the furnace and clamped to the furnace with the gate over the pouring spout of the furnace. The assembly is inverted on trunnions and air pressure is applied to force the metal into the mold. This air pressure does not affect the metallurgical properties of the cast metal, but does assist in driving the molten metal into all crevices and corners in the mold cavity.

Some users of lost wax casting—especially the dentists, jewelers, and non-ferrous specialists—use centrifugal casting machines. Centrifugal force accomplishes the same function as does air pressure in the method just described.

Shrinkage: There are successive dimensional changes encountered at various stages of the process, as follows:

1. During forming of the metal mold. 2. In molding the wax pattern. 3. In drying and baking the investment. 4. In casting the metal.

The total amount of shrinkage in this process is not large but must be carefully evaluated to obtain the best accuracy. Shrinkage varies with size and shape of piece and alloy being cast. As a rough guide, it can be expected that shrinkage through the whole process will approximate 2 per cent with Vitallium. To obtain highest accuracy, the shrinkage must be studied by making test castings for each separate problem and allowing the required extra size in the pattern.

The process is especially useful for forming parts from alloys which are not readily shaped by forging or machining. Such alloys are referred to as refractory alloys and include Stellite and Vitallium, the principle constituents of which are chromium, cobalt, molybdenum, and tungsten. In this respect, the process has been very useful in manufacturing blades and other parts for superchargers and gas turbines.

In considering this—or any specialized process as a possible solution to given manufacturing problems—it is advisable to thoroughly survey all competing production setups to finally reach the most economical method.

Lost wax casting, or any other special production method, is apt to be unsuccessful when used for production of parts which were originally designed with conventional production methods in mind. It is generally true that a designer must be familiar with the special requirements of whatever production methods are used for the parts he designs, if desired quality and economy is to be obtained. For this reason, new techniques cannot well be applied in wholesale fashion throughout an engineering organization but must be gradually introduced as designers and production personnel become increasingly familiar with the new technique.

Automobile Profits Reduced

Automobile manufacturing companies made only one-third to two-fifths as much profit on sales in the war years as the percentage made in peacetime. The average profit, after taxes, for the war years was 2.94% per dollar of sales in comparison with a net profit of 8.25% on sales after taxes in 1939, and a net profit of 7.07% in 1940, according to figures released by Automobile Manufacturers Association.

Throughout the war reductions in the cost of weapons were reflected promptly in price reductions to the Government rather than in profits, largely as a result of applications of automotive production methods.

By A. E. Rylander

Balanced Production With a Tool of Today

Unbalance of Rotative Parts Measured and Corrected by Machine that "Thinks"

A semi-automatic machine—or rather, a combination of two machines—for unbalance measuring and correction, by the Gisholt Machine Company, Madison, Wis., portends remarkable economies, to industry, in the production of automotive crankshafts and other rotating parts that require accurate balancing.

Tersely described, the equipment consists of two electrically connected machines—one, a Gisholt Type B Dynetic balancing machine, the other a special multiple spindle drilling machine. Two operators are required, one for each unit. The first operator takes a crankshaft from a conveyor, loads it into the balancing unit and runs it for balance, the while turning selector switches and weighing dials until all outbalance is neutralized on an indicator.

The points out of balance register on an electrical "brain," which transmits the necessary corrections to the drilling machine. By the time that the shaft has been unloaded from the balancer and shunted to the drilling unit —a matter of about three seconds—the latter has been automatically adjusted to drill out the exact amount of metal, in exactly the right places, required for accurate balance.

Transfer, from unit to unit, is by a dolly running on a short monorail. In handling—as from conveyor line to balancer, from balancer to drill and from the latter back to the conveyor line—procedure is as follows: The first operator places the shaft on two arms and slides it into position. The arms, hydraulically actuated, drop the shaft onto two vibratory supports, when it is coupled to the driver. It is then run for balance.

That done, the arms raise, when the shaft is slid onto the dolly and shunted to the drill. There, it is slid into position on corresponding hydraulic lifts, dropped into place and locked. The operator then presses two buttons, starting the machine, when the drills advance until the points touch the workpiece. From then on, only those drills which are to remove stock advance, each to the exact depth required for balance at its station. The shaft is then unloaded and returned to the conveyor.

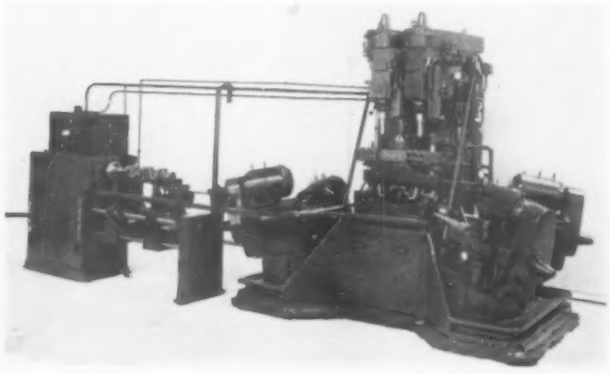
While, at first impression, the outfit may seem somewhat involved, it is essentially simple and suggests remarkably well considered design. Every possible consideration has been given to operator convenience, safety and efficient operation. Handling is so easy that women could easily operate the machine, which is attuned to the *push button age*, with but a minimum of effort.

A green light, on the balancer, flashes as soon as corrections have been transmitted to the drill, when the operator on the balancer may load a new shaft into place. With the 3 second interval, he seldom has to wait. The workpiece cannot be raised, from the balancing supports, until it is uncoupled from the driver, nor can it be raised from the drilling position until all drills are retracted.

To start the drilling machine, the operator presses two buttons, thereby occupying both hands to keep them out of the danger zone. But as for that, there is minimum chance of injury even without this safeguard. No discretion, on the operator's part, is required for correct positioning of the crankshaft. It can only be loaded in the correct position. Nor, does the operator need to worry about dull drills; a red light flashes a signal when resharpening is required.

The really important consideration is the savings that can be effected with automatic balancing and correction, and with operators who may be quickly trained to perform specific functions. And, with a productive rate of thirty or more six throw crankshafts tested and corrected per hour, within tolerances of 0.2 ounce inch, the machine described easily meets all of these requirements.

Below, the Dynetic Balancer, with drilling unit in foreground. At right, closeup of drill, with crankshaft resting on hydraulic lifts.



By Henry J. Burnett

High Frequency Induction Brazing Machine

Engineers of the Pratt & Whitney Aircraft Division of United Aircraft Corporation have developed a machine for the continuous high-frequency induction brazing of steel tips to bronze bodies in the manufacture of valve guide assemblies for use in aircraft engines. Two operators, one assembling and fluxing, and one operating the machine, can do more than 2400 good quality brazed parts during an 8-hour day. A relatively fast operator using manual methods can do about 175 good quality brazed parts in the same period.

Henry J. Burnett **is Electro-Mechanical Process Engineer, Production Engineering Dept., Pratt & Whitney Aircraft Div'n., West Hartford, Ct. A graduate of Worcester Polytech and a registered professional engineer, State of Connecticut, he specializes in electrical process and induction heating research and in the design and construction of electro-mechanical equipment.**

The process is divided into five operations: 1. Cleansing of parts; 2. Assembly; 3. Fluxing; 4. Brazing; 5. Inspection.

As cleanliness is essential to good brazing, the parts are thoroughly degreased. Immediately following the cleaning operation, the parts are assembled. Assembly consists of placing the ring of Easy-Flo Solder on the machined shoulder of the guide and then adding the slotted tip. As soon as possible after assembling, Handy Flux is applied with a clean brush to the internal and external surfaces. Complete coating with flux over the areas to be heated is desirable to minimize surface porosity resulting from oxidation of minute segregations of tin or zinc at 1200°F. After fluxing, the assemblies are allowed to dry. This minimizes the possibility of producing small blowholes in the braze-filled slots due to entrapped steam when the heating operation is performed.

Detached valve guide details consisting of slotted steel tip, ring of Easy-Flo Silver Solder, and bronze body; assembly prior to fluxing; final brazed valve guide assembly ready for further machining.

Brazing occurs when the assemblies are placed on a moving belt and passed through an inductor coil. Gradually the temperature rises to approximately 1200°F., and at that point a pushdown wheel presses the bronze body firmly into the steel tip. After passing out of the inductor coil the assemblies cool down below 800°F. and drop into a tank containing hot water. After a few minutes immersion, the guides are removed from the tank and are then inspected for quality of braze, surface porosity, and alignment.

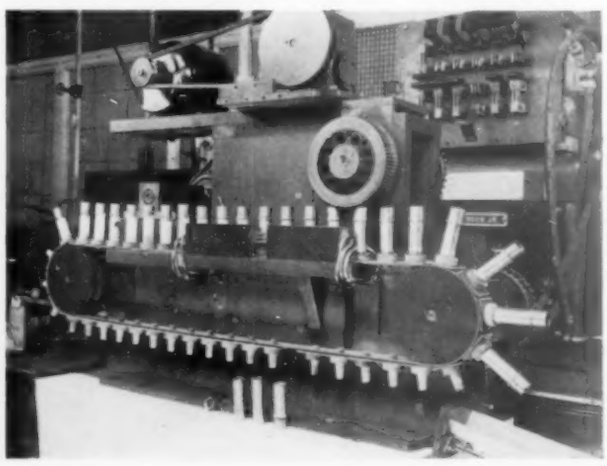
Except for bearings, shafts, and other miscellaneous hardware, the frame of the brazing mechanism is made of micarta flat-stock. As micarta has excellent strength and insulation characteristics it is ideal for an application of this nature where stray electrical fields ordinarily would cause heating in a metallic structure.

At the top of the machine the driving motor is V-belt connected to a reduction gear which drives a continuous chain and sprocket arrangement on the rear of the mechanism. By means of small shafts extending from the sprockets to the front of the mechanism, the right-hand belt drum and the upper pushdown roll are driven at the same speed.

Of the two belt drums, the driver at the right is serrated, while the one at the left is an idler and guide. Drums and belt move clockwise. Both drums are square-grooved in the center of the face to provide guidance for the rubberized canvas belt. Equally spaced pilot-type buttons made of transite are fastened to it by cheese-head micarta screws. These screws serve as guides as they move into the square-grooved drums. Fastened between the transite buttons and the belt, small "platforms" made of $\frac{1}{8}$" thick micarta provide extra stability for the valve guides when pilot-mounted on the transite buttons.

The inductor coil assembly consists of (1) an elongated inductor coil with parallel sides through which the guide assemblies pass when the belt is in motion; and (2) a square-grooved base support which extends beyond both ends of the inductor coil. Over this base the upper portion of the

Caught with its guards off, the "Rube Goldberg," as it is known on the job, facilitates the brazing of valve guide assemblies with Easy-Flo Silver Solder. "Rube" consistently produces uniform brazes at a production rate of 300 to 600 assemblies per hour.



belt is laterally guided by the cheese-heads of the micarta screws. This base also prevents the sagging of the belt and uniformly sustains the guide assemblies during the progressive heating process.

A pushdown roll, above the belt and near the end of the inductor coil, has a flexible rubber center and a serrated copper rim. This roll revolves at a peripheral speed equal to the linear speed of the belt and is so positioned that as each heated guide is drawn under it, a downward pressure is exerted. This pressure assures proper seating of the bronze guide into the steel tip after the ring of brazing material has melted.

A "Tocco Jr." induction heating generator of the 9600 cycle type supplies the heating power for the brazing operation. A foot-switch operated contactor on the generator panel connects the generator directly to an anti-resonant circuit which consists of the inductor coil and variable bank of capacitors electrically connected in parallel.

To operate the brazing machine, the driving motor is started and 25 kw of 9600 cycle high frequency power is applied to the inductor coil. Properly assembled and fluxed valve guides are placed on the pilot type transite buttons. The belt moves about one-half inch per second. As the guide assemblies enter the inductor coil, heating begins immediately and continues until the assemblies clear the right end of the inductor. As the guides approach the push-down wheel, a temperature of 1175°F. has been attained and the silver solder flows into the bonding area. After the push-down wheel closes the gap between the steel tip and the bronze body, the assemblies pass beyond the end of the inductor coil where solidification of the silver solder begins.

A sufficient distance of belt travel from the end of the inductor coil to the discharge point is allowed for the complete solidification of the bonding material. However, to make it possible for the assemblies to fall by gravity from the transite buttons into a small trough placed to receive them, it is necessary to avoid too great a travel distance or cooling down time. If the temperature drops too low, the Handy Flux also solidifies and causes the assemblies to be retained on the belt.

When dropped into the small trough, the assemblies slide into a tank of hot water where the adhering flux is removed by a few minutes of "soaking." After removal from this tank the guides are dried, inspected and passed on to the shop for machining.

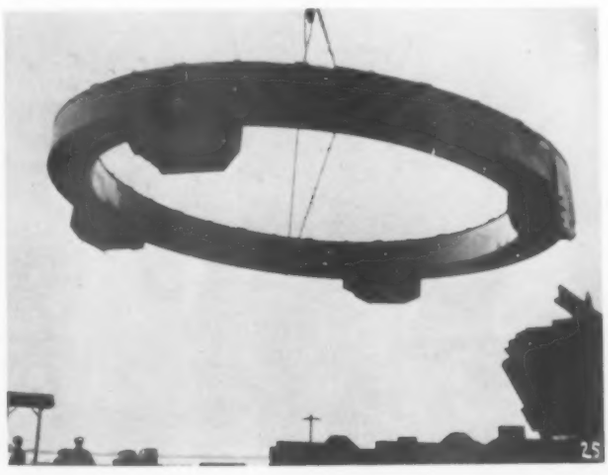
A "Bridge" to Span Eons

California Institute of Technology scientists are resuming work on the world's largest telescope, progress of which was interrupted by the war. Installed atop Mt. Palomar, this 200-inch giant is expected to bridge a billion light years and must be sighted with an angle of error so small that, at three miles, two lines drawn from a single point would be only one inch apart.

Resumption of work, on the telescope, recalls many of the ticklish engineering problems involved in building the huge 500-ton mounting that will support the 200-inch mirror and optical system. Toughest of these, was the job of fabricating and machining the 317,000-pound horseshoe bearing on which the telescope will ride. The bearing, with the rest of the mounting, was built at the Westinghouse works in South Philadelphia, and a boring mill had to be enlarged to a diameter of 44 feet to handle the job. Every day at 4 P.M., the bearing began to swell from the sun's heat—sometimes as much as 0.013". At night it contracted. Engineers finally built a "sun-bonnet" around the bearing that reduced temperature fluctuations by 50 per cent.

The bearing must support a million-pound load and it was necessary to literally bend it out of shape so that it would be squeezed back into a perfect circle when the telescope rested on it. The bearing will run on oil pads with such frictionless smoothness that it could be turned by a motor having less than half a horsepower, this in spite of the fact that the telescope and its supporting structures have the proportions of a six-story building. If conventional roller bearings had been used, the friction would have been 600 times greater.

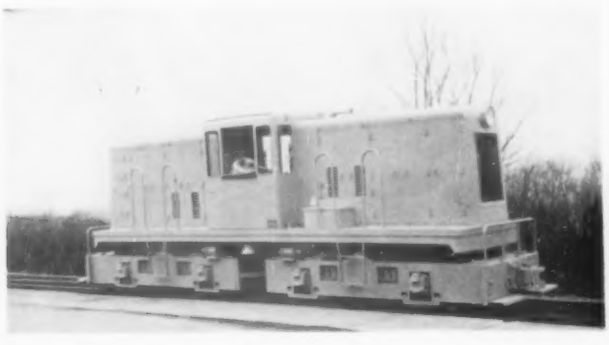
Shown as it started on its trip to California several years ago, this giant ring is a measure of the size of the 200-inch Mt. Palomar telescope.



Narrow Gage Diesel-Electric

Five special 400 hp, 36-inch gage industrial diesel-electric locomotives have been recently completed by General Electric for use on the 40 miles of narrow gage track, South Works Plant, Carnegie-Illinois Steel Corp'n.

The 65-ton locomotives are geared for top speed of 25 mph, and are equipped with two 2-axle trucks of articulated design suitable for operation on 50' radius curves. Each locomotive is powered by two Cummins HBIS-600 diesel engines, nominal rating 200 hp at 1800 rpm each. Four GE 733, six-pole, dc, commutating pole, integral double-reduction geared traction motors, one per motor, provide locomotive drive.



By Anders Jansson

New Press Designed for Fine Perforating Operations

A New Tool, by an Old Maker, Combines Convenience with Exact, Continuous Performance.

Of more than usual interest, especially to production executives in stamping plants, is the new **PERFORATING PRESS** recently developed by the *E. W. Bliss Company* at their Toledo plant. The first of its kind to be designed by Bliss engineers, and therefore a departure from the regular line of the company, the new press is of 75 tons capacity and was especially designed for fine perforating operations requiring precision dies and extreme accuracy in the feeding mechanism.

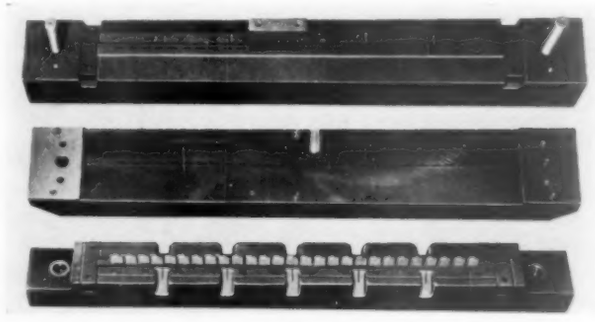
The frame is of solid design, with a mass of metal, concentrated in the head and crown, to properly dampen the vibration waves of constant frequency often set up as a result of continuous operation at high speeds. The crown is of semi-tubular sections for greater rigidity. A very heavy slide is guided in precision bronze ways, and connections are of the solid steel ball type with adjustable ball seat and constantly submerged in oil. Both slide and connections are adequately balanced by enclosed coil springs.

The crankshaft is of the full eccentric type and runs in bronze bearings, with the drive shaft and flywheel running in Timken roller bearings. One nice feature, of design, is the use of helical steel gears, thereby obviating the chatter often caused by straight cut gears and, at the same time, adding to quietness. The clutch, of disc type with integral brake discs, is activated by a quick acting, solenoid operated air valve, and controlled by conveniently located push buttons for start, top stop and "inch." Louvers, for ventilation of the clutch, are provided in the flywheel guard, in case of frequent inching; under normal conditions, however, the clutch is operated only occasionally, as when starting and stopping the machine for insertion of new sheets or roll strip.

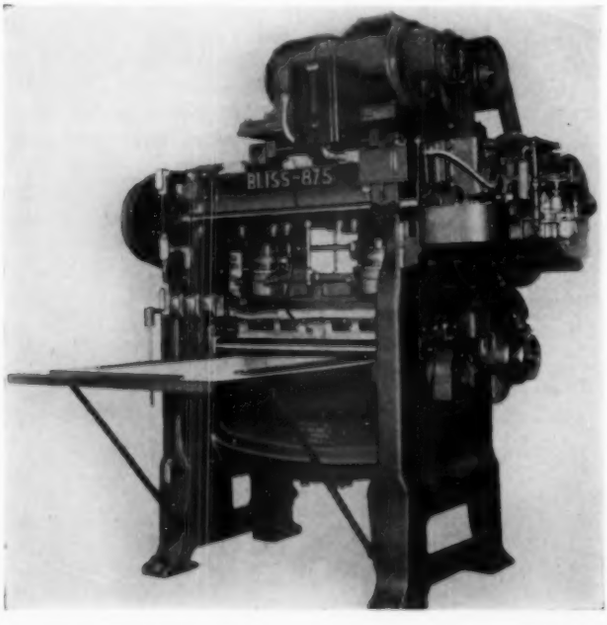
Drive is by a Reeves Vari-Speed Drive Unit, and an adjustable cam on the feed shaft, operating through a rotary unit switch, is graduated to correspond with numbers on the drive unit. Feed is of the double roll type and is driven from an adjustable feed crank located on the right-hand side of the press. The feed rolls are of hardened and ground alloy steel, run in bronze bushings and, remaining in perfect alignment, insure exact, continued performance. A new type of releasing mechanism, operated by a lever, releases back rolls simultaneously; in addition a substantial feed table, with side and back gages and including guides for the sheets between the feed rods and dies, completes the handling equipment.

The press is designed to accommodate sub-press die sets, which may be slid onto the top of the bolster from the left side through an opening in the housing. They are fastened to the slide and belt by conventional bolts. Operation sequences are substantially in line with prevailing automatic press operation, and sheets may be straightened on rollers.

Typical set of perforating dies used with the Bliss 875 Press.



Quarter view, from front, of Bliss 875 Press. Note compact design and neat grouping of the various units.



Quarter view, from rear, Bliss 875 Press. Note opening, left side of press, for insertion and removal of dies.

A.S.T.E. NEWS

NEWS OF INTEREST AND ABOUT MEMBERS

Many Chapters Contribute Committeemen

ASTE President Names National Chairmen

APPOINTMENTS TO 1946-47 National Committees of the American Society of Tool Engineers have been announced by President A. M. Sargent.

Personnel of the several departments of the Society's operation has been carefully chosen, the President appointing the National Chairmen who, in turn, name the members of their respective committees.

Valuable assistance has been rendered by the various Chapters in suggesting members who have given outstanding service in local or national offices. Past performance has been considered in an effort to select men fitted by knowledge or experience to function effectively in the offices designated.

Heading the National Constitution and By-Laws Committee is Ray H. Morris (Hartford), Past President and Chairman of the recently-retired Organization Progress Committee who prepared the revised Constitution and By-Laws and the operational procedures now being used by all officers of the Society.

Practically all sections of the country are represented in the men Mr. Morris has chosen to serve on his committee: Edward J. Berry (Little Rhody), Earle W. DeBisschop (Rochester), Thomas J. Donovan (Philadelphia), Jacob J. Demuth (St. Louis), Henry H. Hagedorn (Golden Gate), Charles F. Staples (Pontiac), Horace R. Wentzell (South Bend), and George W. Wise (Twin City).

W. B. McClellan (Detroit) is Chairman of the National Editorial Committee. Incumbent Chairman of Detroit Chapter and a former member of the National Program Committee, Mr. McClellan conducted one of the technical sessions at the 1946 Annual Meeting in Cleveland.

He has chosen K. C. Jasper (Louisville) and Foster C. Koehn (Milwaukee) to work with him on his new assignment.

O. W. Winter (Buffalo-Niagara Frontier), Education Chairman of long standing, has again accepted this office. Through his patience, perseverance and unflagging efforts, the necessity for Tool Engineering curricula is being recognized in foremost universities, colleges and technical schools.

ASTE'ers actively engaged in teaching engineering or in promoting the Society's educational program make up Mr. Winter's committee. The committeemen are: E. M. Bertschi and L. J.

(Continued on Page 50)

F. W. Eaton

H. D. Hall

C. V. Briner

R. H. Morris

R. B. Douglas

W. H. Smila

E. W. Dickett

J. A. Siegel

O. W. Winter

W. B. McClellan

E. W. Kay

E. W. Ernst

IN THIS ISSUE

Chapter	Page
Atlanta	58
(Aurora) Fox River Valley	56
Boston	59
Buffalo-Niagara Frontier	53
Chicago	59
Cincinnati	53
Dayton	51, 53
Decatur	52
Detroit	51, 53, 56, 58
Elmira	58
Erie	55
Fort Wayne	52
Hamilton	55
Hartford	57
Houston	51
Kansas City	50
Los Angeles	50, 54
Milwaukee	55
New Orleans	52
New York, Greater	57
Philadelphia	51, 57
Pontiac	56
(Providence) Little Rhody	54
Racine	55
Rochester	53
Rockford	55
(San Francisco) Golden Gate	52
Seattle	52
Springfield (Ill.)	50
St. Louis	58
Toledo	51, 57
Toronto	58
(Washington, D.C.) Potomac	56
Williamsport	57
(York) Central Pennsylvania	51, 59
Coming Meetings	55
Situations Wanted	55
"Tool Engineers' Handbook"	60

(Continued from Page 49)

Fletcher (Peoria), Foster M. Crayton (Philadelphia), Roy E. Bender and Joseph I. Karash (Cleveland), Lloyd A. Sheeran (Little Rhody), Prof. O. W. Boston and O. B. Jones (Detroit), Jay N. Edmondson (Columbus), Charles C. Gorham (Boston), Chris A. Vogt (Houston), Prof. Halsey Owen of Indianapolis, C. Douglas Wright (Niagara District), August C. Arends (San Diego), Sherman B. Hagberg and Milton L. Roessel (Rochester).

The new Membership Chairman is E. W. Dickett (Rockford). A former Director and Vice-President of the Society, Mr. Dickett has been active in ASTE affairs for many years.

Appoints 12 Committeemen

Assisting him are: Howard Volz (Columbus), Herbert A. Bachman (Detroit), L. M. Cole (Houston), Fred J. Dawless (New Haven), John I. Junkin (Louisville), James O. Knight (Peoria), C. John Lindegren (Worcester), Edward M. McLernon (Baltimore), H. D. Mozeen (Syracuse), Milburn M. Ross (Wichita), John M. Rudel (Montreal), and William H. Scheer (St. Louis).

H. D. Hall (Northern New Jersey) continues in office as Chairman of the National Program Committee. First Vice-Chairman is Robert W. Ford (Pittsburgh), Second Vice-Chairman, E. W. Baumgardner (Cleveland), and Secretary, Stephen Urban (Syracuse). Other members include F. J. Schmitt (Chicago), H. E. Linsley (Northern New Jersey), F. E. Doty, Jr. (Houston), and Hayden R. Shearer (Indianapolis)

Public Relations policies will be guided by C. V. Briner, Immediate Past President and indefatigable Past Chairman of the former Organization Progress Committee.

Aiding Mr. Briner are W. J. Gamble (Buffalo), H. E. Campbell (Cincinnati), W. W. Young (Boston), Stanley H. Grattan (Detroit), R. Eric Crawford (Toronto), Harry B. Osborn, Jr. (Cleveland), Harry H. Whitehall (Hamilton), and Michael J. Radecki (New Haven).

Standards Setup Unchanged

Re-appointment of W. H. Smila (Detroit) to the chairmanship of the National Standards Committee assures uninterrupted progress on this important phase of ASTE work.

His committee remains intact with W. F. Wagner, H. T. Johnson, L. B. Bellamy, Grant S. Wilcox, Jr., and William Moreland (Detroit), E. J. Marasko (Cleveland) and W. H. Thomas (Windsor, Ont.).

Publication of the "Tool Engineers' Handbook" will go forward under the supervision of E. W. Ernst who has chairmanned this venture since its inception.

In addition to his former committee lineup, consisting of Frank W. Curtis (Springfield, Mass.), Robert B. Douglas (Montreal), Frank Martindell (Chicago), A. L. Potter (Detroit), and Handbook Editor Frank W. Wilson, Ben C. Brosheer (Chicago) and Harry Crump (Detroit) will participate in this work which is rapidly approaching its climax.

Budget preparation will again be in the hands of Finance Chairman F. W. Eaton (Detroit), a former National Treasurer and Secretary.

Committeemen chosen by Mr. Eaton are W. J. Frederick (Cincinnati), retiring National Treasurer, and Louis L. Weber (Cincinnati), P. W. Brown (Northern New Jersey), L. G. Singer (Toronto), former National Assistant Secretary-Treasurer; Hallet D. Jones (Williamsport), George Goodwin (Dayton), G. C. Johnson (Rockford), and National Treasurer V. H. Ericson (Worcester).

The development of Honor Awards to be sponsored by the Society for distinguished achievement in tool engineering will proceed under the chairmanship of National Secretary R. B. Douglas (Montreal) who handled the preliminary research on this project during his '45 term.

E. Wayne Kay (Detroit) will serve a second year as Chairman of the ASTE Directory, now a permanent adjunct to *The Tool Engineer*.

The Judicial Committee, automatically composed of the nine Past Presidents oldest in term of office, consists of: Joseph A. Siegel, Chairman; Walter F. Wagner, T. B. Carpenter, William H. Smila and Frank A. Shuler (Detroit), Frank W. Curtis and James R. Weaver (Springfield, Mass.), A. H. d'Arcambal (Hartford), and Robert M. Lippard (Worcester).

With the exception of a few unconfirmed appointments, the 1946 administration is now complete and operating in conformance with the Society's organization charts.

ASTE National Education Chairman O. W. Winter chats with officers and guests attending May 20 special meeting of Kansas City Chapter. Left to right: Harvey Essman, Education Chairman, St. Louis Chapter; Bruce Williams, member of Board of Professional Engineers, Jefferson City; Willis G. Ehrhardt, Past Chairman and National Delegate, St. Louis Chapter; A. N. Brunson, Chairman, Kansas City Chapter; J. J. Demuth, Chairman, St. Louis Chapter, and Mr. Winter.

NMTBA Head, Speaker At Executives Night

Springfield, Ill.—An outstanding address on "Co-ordination of Machine Tools and Tool Engineering" was presented by William P. Kirk, Vice-President in Charge of Machine Tool Sales, Pratt & Whitney, Div. Niles-Bement-Pond Co., West Hartford, Conn., speaking May 7 before members and guests at Springfield Chapter's Executives Night held in Hotel Abraham Lincoln.

W. P. Kirk

Mr. Kirk, who is President of the NMTBA, is widely known for his varied professional activities, including war service with several government agencies.

Prior to Mr. Kirk's address, John V. Javorsky, Past Chairman of the Chapter, gave a vivid account of his visit to the ASTE New Era Exposition at Cleveland and the influence on tomorrow's manufacturing of the remarkable new equipment displayed at the Show.

Stress Professional Side Of Tool Engineering

Kansas City, Mo.—Dinner speaker at a special meeting of Kansas City Chapter, May 20, was O. W. Winter of Buffalo, N. Y., Chairman of the ASTE National Education Committee.

Mr. Winter gave a very forceful talk on "Professional Aspects of Tool Engineering," relating its history and trend toward specialization, with the resultant organization of ASTE. Grown from a 1932 depression baby to the world's second largest engineering organization, the Society, stated Mr. Winter, is entitled to the full professional recognition accorded lawyers, doctors, architects, and others.

Discusses Registration

Bruce Williams of the Engineering Div., Missouri State Board of Registration, followed Mr. Winter, giving a brief but thorough explanation of the requirements for registration as an engineer in this State. Mr. Williams' detailed answers to questions from the floor indicated that many of the members were eligible for registration by examination in the State of Missouri.

The subsequent discussion among the group disclosed considerable interest in registration.

Guests included J. J. DeMuth, Chairman; W. G. Ehrhardt, Past Chairman; and Harvey Essman, Education Chairman of St. Louis Chapter, ASTE.

High Speed Presses Inspect, Sort Parts

Los Angeles, Calif.—Guest speaker at a recent meeting of Los Angeles Chapter was Herman F. Zorn, President and General Manager of The V & O Press Co., Inc., Hudson, N. Y.

H. F. Zorn

Mr. Zorn lectured on "Presses Geared for Automatic Production," illustrating his subject with slides and motion pictures. The presses shown in operation, not only make parts but also automatically inspect them, rejecting faulty ones.

Micro-switches are used extensively in the inspection cycle of the machines, some of which operate as fast as 1100 cycles per minute.

Attendance at the dinner meeting, held in Scully's Cafe, was 164. Guests were introduced by Chairman Anton Peck during the serving of dinner.

Predicts Important Role For Crush Grinding

Toledo, Ohio—More than a hundred engineers had the pleasure of hearing J. C. Wilson, Chief Engineer and Sales Manager, Thompson Grinder Co., Springfield, Ohio, address a meeting of Toledo Chapter, May 8, at the Toledo Yacht Club.

Mr. Thompson's subject, "Tru-Forming Method of Crush Dressing Grinding Wheels," was illustrated with a silent film.

The speaker held the attention of his audience throughout his talk with clear explanation of crush dressing, the varied contours possible, and the rapid renewal of metal comparable in many instances to milling operations.

Proof of the practical application of crush wheel grinding was evident in the remarkable display of parts ground by the crush wheel method, a definite time, labor and cost saving innovation compared to conventional grinding methods.

Mr. Wilson assured his audience that crush form grinding, because of its practicability, is not a passing fancy. It readily lends itself to a simple means for exact duplication and mass production. New developments, he said, are continually being explored and further refinements are possible.

This form of metal renewal, the speaker predicted, will eventually rank in importance between milling and broaching.

Among guests present were W. G. Boldenhofer, Vice-President, and Harvey Hallenberg, Local Representative of the Thompson Grinder Co.

Sagers with Bunell

Philadelphia, Pa. — Robert S. Sagers has been appointed Eastern Sales Representative of The Bunell Machine and Tool Co., Cleveland, Ohio, according to announcement by R. J. Swing, General Sales Manager of the company. Mr. Sagers will use Philadelphia as his headquarters.

R. S. Sagers

A member of Philadelphia Chapter, ASTE, he is eight years experienced as Process and Sales Engineer for special tools and machines, dies, jigs and fixtures.

Pantographing Techniques Shown in Motion Pictures

Houston, Tex.—Houston Chapter held its final spring meeting on May 14 at the Golfcrest Country Club. Approximately 100 members were in attendance to hear the main speaker, Harlow Klema, Asst. Sales Manager, George Gorton Machine Co., Racine, Wis., and to view the film, "An Exact Duplicate."

Mr. Klema gave a brief history of pantographing and other duplicating mechanisms and answered questions from the floor. His program was thoroughly enjoyed, the display of products made on Gorton machines creating considerable comment.

The coffee speaker, C. F. Hanson, a former Lt. Commander in the Navy, related humorous incidents concerning his experiences in the South Pacific, in his talk, "The Human and Humorous Side of the Island War."

Announcing that all members would be expected to participate in a membership drive during the coming year, Chairman John C. Preston stressed the importance of building membership through the summer recess.

A color film entitled, "The Alaskan Highway," completed the evening's program.

Refreshments were served, and 15 visitors were introduced.

ASME Advances Harrison To Fellowship

Chambersburg, Pa.—Com. R. E. W. Harrison, Vice-President of the Chambersburg Engineering Co., has been accorded the honor of promotion to Fellowship in ASME.

R. E. W. Harrison

A veteran of two World Wars, Com. Harrison served as a special assistant to the Under-Secretary of the Navy during his last tour of duty.

Earlier business connections, before joining the Chambersburg Co. in 1935, include the posts of Director of Engineering for the Grinding Machine Div. of Cincinnati Milling Machine Co., and Chief of the Industrial Machinery Div., U. S. Department of Commerce.

He is a member of Central Pennsylvania Chapter, ASTE.

Wilcox Elected Chairman ESD Affiliate Council

Detroit, Mich.—Grant S. Wilcox, Jr., Assistant Master Mechanic, Plymouth Div., Chrysler Corp., Detroit, was elevated on June 5 to the Chairmanship of the Affiliate Council, Engineering Society of Detroit.

G. S. Wilcox, Jr.

Composed of two representatives of each of the 32 Detroit Engineering Societies affiliated with the ESD, this body is charged with the coordination of all Affiliate group activities in public and professional matters.

During the past year, as Vice-Chairman of the Council, Mr. Wilcox has actively supported a program of Refresher Courses for Affiliate Society members, preceding their State Board examinations for registration as Professional Engineers.

Mr. Wilcox, a member of Detroit Chapter, ASTE, has successively served his Chapter as Editorial Chairman, Vice-Chairman and Chairman. At present he is a National Director-Elect and Chairman of the Data Sheet Sub-Committee.

Ohio Group Pays Tribute To "Oldtimers"

Dayton, Ohio—Charter members, "oldtimers" and Past Chairmen were honored by Dayton Chapter at a well-attended meeting, May 13, in the Miami Hotel.

Immediately after dinner an outstanding program of professional entertainment was presented.

Following this feature, Stephen Johnston, Manager of Engineering and Sales for the Johnston Gauge Co., Bloomfield, Conn., lectured on "Quality Control Problems in Screw Threads."

Mr. Johnston was introduced by Program Chairman Ralph Lilleberg, Sales Manager of The Sheffield Corp., Dayton. As Mr. Lilleberg's company also manufactures screw thread gauges, he and Mr. Johnston engaged in some good humored repartee, lightening the serious character of the technical address.

A lively discussion period followed Mr. Johnston's well-presented talk.

Dayton Chapter members met May 13 at the Miami Hotel to honor charter members, "oldtimers" and Past Chairmen and to hear Clinton V. Johnston of the Johnston Gauge Co., Bloomfield, Conn., discuss "Quality Control Problems in Screw Threads." At the speakers' table (left to right) are: (First man unidentified), George Tillotson, Past Chairman; Ralph Lilleberg, Program Chairman; Mr. Johnston, the guest speaker; Adam Lensch, Chairman; George Goodwin, Earl Johnson, Walter Olt and H. O. Poock, all Past Chairmen. Vacant chair was later occupied by Russell Miller, Secretary.

Meehanite Resists Heat, Absorbs Vibration

Decatur, Ill.—Dinner at the Decatur Club preceded the June 10 meeting of Decatur Chapter, attended by 31 members and guests, including visitors from Bloomington and Shelbyville, Ill.

After the dinner and usual business session, Chairman C. E. White turned the meeting over to Program Chairman Ray Howell who introduced the technical speaker, W. E. Illig, Vice-President and General Manager of the Banner Iron Works, St. Louis, Mo.

Mr. Illig, in a most instructive discussion of "Castings and Their Interest to the Tool Designer," pointed out that the gap between cast iron and steel is bridged by the metal known as Meehanite.

The speaker also presented a sound film, "Meehanite Means Better Castings." Both speaker and film stressed Meehanite's absorption of vibration and high resistance to corrosion, wear and heat.

Mr. Illig's address, one of the outstanding presentations of the season, was augmented with an excellent display of Meehanite castings.

Mr. Howell announced that the speaker for the November 11th meeting would be Chester Mott, Metallurgist, Fansteel Metallurgical Corp., North Chicago, Ill. Mr. Mott's subject will be "Hard Facing of New Tools and Its Use in Tool Repair."

Lectures, Demonstrates Modern Communication

Seattle, Wash.—Principal speaker at the May 14 dinner meeting of Seattle Chapter, held in the Gowman Hotel, was Tex Anderson, Sales Associate of Radio Laboratories, Inc., Seattle, who discussed the electronic telephone and modern systems of communication in large industrial plants and offices.

Mr. Anderson's lecture was accompanied by a colorful demonstration.

Before the technical session, Capt. George Baccus of the Army Service Command explained the operation of a Quartermaster Truck Company in World War II, stressing the organization and management necessary.

Arrangements for the speakers were made by Carl Fields, ASTE National Director, and Production Manager of Coast Plastics Corp., Seattle.

Arthur G. Means, Jr., (left) retiring Chairman of Seattle Chapter, congratulates his successor Kenneth E. Bergerson, on his recent election.

Photo Courtesy Western Machinery and Steel World

Soup cools as officers of Golden Gate Chapter listen absorbedly to Prof. Paul L. Kirk's views on the future of atomic energy. Professor Kirk (right) of the Bio-Chemistry Department, University of California, speaking at May 15 dinner meeting of Chapter, gave members an insight into possibilities of the application of atomic power. At left are Ernest C. Holden and Edward J. Raves.

Nitriding Co-Featured With German Methods

Fort Wayne, Ind.—The 80 members attending Fort Wayne Chapter's May 8 dinner meeting were addressed by Roscoe E. Smith, Secretary of the Reliance Electric and Engineering Co., of Cleveland, Ohio.

A. F. Holden

Mr. Smith, who recently returned from a tour of industrial plants in France, Germany and Italy, talked on "What Is Left of Industrial Germany." According to Mr. Smith, the chief obstacles to rebuilding bomb-flattened factories in Germany are the lack of even a base communications system and German workers' preoccupation with the food problem.

The Allies' major effort now is in getting German plants operating again. Since Germans who cooperate in this program secure the best food rations, the Allied Governments are beginning to make progress.

The speaker illustrated his talk with pictures showing contrasting methods and procedures used by Germans and Americans in the manufacture of electrical equipment.

A. F. Holden, President of the A. F. Holden Co., lectured on "The Use of Salt Baths in Heat Treating Tools."

Mr. Holden illustrated his talk with slides showing various furnace illustrations and types of parts hardened.

In the ensuing discussion, the engineers presented some of their own problems on quenching and nitriding of steels.

See Evolution of Bronze In "Golden Horizons"

New Orleans, La.—The popular motion picture, "Golden Horizons," chronicling the bronze industry, was viewed by New Orleans Chapter members at their May 14 meeting in the Jung Hotel.

W. W. Swan, local representative of Ampco Metals, Inc., Milwaukee, Wis., presented the film, subsequently speaking on the general development and use of Ampco metals. His remarks were illustrated with a second film showing actual production of Ampco metal parts.

An exhibit of Ampco metal was inspected at the conclusion of the program.

Atomic Power Possible Within Year, Kirk Says

San Francisco, Calif.—Prof. Paul L. Kirk of the University of California, who has been actively engaged in atomic research projects for the past three years, gave some exceedingly interesting views on what may be expected in this field, both from the political and the economic standpoint, at the May 15 dinner meeting of Golden Gate Chapter in the Engineers Club.

Briefly sketching the advance of scientific investigation from earliest discoveries to the present day knowledge of nuclear physics, the speaker forecast an enormous development in the practical application of recent findings, during the next 25 years.

Uranium Hard to Machine

Of particular interest to the engineers present was his account of technical problems involved in the manufacture and use of uranium. The physical characteristics of this metal, he said, are such that ordinary machining operations are most difficult to carry out, requiring special techniques to cope with its peculiarities.

"Atomic power can be produced commercially within one year," said Professor Kirk. As he outlined some of the future possibilities of the practical application of atomic energy, he drew a fine distinction between the constructive and destructive uses of this dynamic science.

Pointing out that there is no defense against the atomic bomb, except peace, the speaker stressed the need for complete understanding among all nations regarding the enormity of the problems of the Atomic Age. He urged organized collaboration in the effective solution of those problems upon which so much of the future welfare of humanity depends.

Professor Kirk was connected with the Manhattan Engineering Project from August, 1942 to 1945. During the first six months of this period, he was with the Radiation Laboratory at the University of California. He was next associated with the Plutonium Project at the Metallurgical Laboratory of the University of Chicago. His last nine months on the atomic project were spent at Richland, Wash., in the manufacture of plutonium.

A film, entitled "Call for Quantity" and released by the Curtiss-Wright Corp., completed an enjoyable evening. The picture showed in great detail the building of pursuit ships for the U. S. Army Air Corps.

Production Key to Crisis Van Deventer Predicts

Cincinnati, Ohio—Over 300 members and guests met at the Alms Hotel, May 11, for the Eighth Annual Dinner of Cincinnati Chapter.

Featured speaker was John H. Van Deventer, President and Editorial Director of *The Iron Age*.

J. H. Van Deventer

Mr. Van Deventer chose as his subject, "Tools for Tomorrow," devoting his talk primarily to present day trends and their eventual results. He predicted that the 130,000,000 American people would ultimately subdue the belligerent labor leaders now harassing the country. Labor, management and government, he warned, must work together. Productivity, up to now almost never mentioned by the government, will be the chief factor in settling the turmoil we are now experiencing, Mr. Van Deventer indicated.

Following dinner, C. W. Stricker, retiring Chairman, introduced Lorin Hayden, his successor.

Mr. Hayden presented the Hon. James G. Stewart, Mayor of Cincinnati. In a short speech, the Mayor urged tool engineers to continue the good work done during the war. In so doing, he said, the insidious forces working from within would surely be crushed.

A. M. Sargent, ASTE President, spoke briefly on national affairs of the Society.

Local Industry Represented

Executives from Cincinnati machine tool companies who were guests at the function included William Dermody, Secretary-Treasurer, Carlton Machine Tool Co.; Fred Schoeffler, Vice-President, Lodge & Shipley Machine Tool Co.; Walter Tangeman, Vice-President, The Cincinnati Milling Machine Co.; Charles E. Gilbert, President, Cincinnati Gilbert Machine Tool Co.; C. Bradley, Tool Engineer, The Cincinnati Planer Co.; Perrin G. March, III, President, The Cincinnati Shaper Co.

Alfred Kullman, Vice-President, The American Tool Works; Charles E. Wood, Assistant to the President, Lunkenheimer Co.; C. R. Thompson, General Manager, American Can Co.; W. A. Rentschler and A. C. Wais, Vice-Presidents, General Machinery Corp.; J. Walter, Engineering Vice-President, The G. A. Gray Co.; E. A. Muller, Chairman of the Board and Treasurer, The King Machine Tool Co.; Herbert Murrer, President, Modern Tool Co.

E. M. Staples, President, Staples Tool & Engineering Co.; Millard Romaine, General Manager, Cincinnati Lathe & Tool Co.; Frank Kise, Secretary, The Williamson Heater Co.; C. G. Slete, Vice-President, Cincinnati Bickford Tool Co.; and Thomas Harris, General Manager, Victor Electric Products Co.

Explains New Indexing Of ASTE Data Sheets

Detroit, Mich.—More than 300 members of Detroit Chapter were present for the final meeting of the season held June 13 at the Rackham Memorial Building.

Grant S. Wilcox, Jr., Chairman of the Data Sheet Sub-Committee of the National Standards Committee, spoke on the progress of his Committee's activities, describing the new index which has been developed for the Society's Data Sheets.

He impressed upon the members the simplicity of the filing system worked out for quick reference to any specific data sheet, and the desirability of this engineering information to prospective members of the Society.

Other members of the Data Sheet Sub-Committee attending the meeting included W. H. Thomas of Windsor Chapter, L. B. Bellamy and William Moreland of Detroit Chapter.

In a film-illustrated talk, Canfield Cook revealed new developments to be expected in the air world of tomorrow.

Siegel Joins Doyle Mfg.

Syracuse, N. Y.—Allen C. Siegel, formerly Factory Superintendent at Uebelhoer Bros., Inc., Buffalo, is now associated with Doyle Mfg. Co., Syracuse, as Factory Manager.

Mr. Siegel has been active in tool engineering and supervisory positions in the aircraft industry since 1930, serving in various executive capacities at several Curtiss-Wright plants before joining Uebelhoer Bros. in 1945 to manage production of warplane parts.

He is a Past Chairman and member of the Executive Committee, Buffalo Chapter, ASTE.

Recognized by Ordnance

A certificate of appreciation is presented to Louis Polk, President of the Sheffield Corporation, Dayton, Ohio, by Col. C. H. Deitrick, Chief, Cincinnati Ordnance District, representing the Secretary of War. The award is for "outstanding service rendered to the Ordnance Department in time of war."

In expressing his appreciation, Mr. Polk said he accepted it on behalf of his fellow workers as a symbol of their efforts in meeting the country's wartime needs. Mr. Polk is a member of Dayton Chapter, ASTE, and a director of the Cincinnati Post of the Army Ordnance Association.

"Prof." Oakes Entertains With Loony Inventions

Rochester, N. Y.—Past Chairmen of Rochester Chapter were honored May 10 at a dinner meeting held in the Powers Hotel.

James Horne, acting as Master of Ceremonies, introduced each Past Chairman with a brief resume of the important events of his administration. He also read a telegram from John Bartek, the first Chapter Chairman, who was unable to be present.

Chairmen succeeding Mr. Bartek are: Charles Codd, John Dense, Cecil Lucas, Clifford Sears, Joseph Schick, Chauncey Newton, Earle DeBisschop, and Charles Seely, the present incumbent.

After the social hour and dinner, the 150 members and guests present were entertained by "Professor" Russell E. Oakes with his absurd inventions which he is promoting as "Postwar Products with a Punch."

Analyzes Mental Processes

"Professor" Oakes maintains that he is a proponent of "right thinking" which all tool engineers should use. He claims to have found the lost cow by thinking what he would do and where he would go if he were a cow, subsequently finding the stray animal and receiving a suitable reward.

The audience was amused by his demonstration of the self-finding golf ball, the chatter eliminator worn over the ears, the dripless donut dunker, the bird cage cover for the butter (if you have any), the rotary spaghetti fork, the automatic sheep counter for insomniacs, and his sure-fire cigarette lighter which sometimes works.

The "Professor" is widely known not only from personal appearances in all parts of the United States, but also for his roles in Hollywood motion pictures, "Hobby Lobby" radio broadcasts, and through magazine and newspaper stories.

Guests of honor at May 10 dinner meeting in Powers Hotel were Rochester Chapter Past Chairmen. Left to right: Past Chairmen Clifford Sears, Cecil Lucas, John Dense and Charles Codd; Chairman Charles Seely, "Professor" Oakes, the featured attraction of the evening; and James Horne, the "M.C." At right, "Professor" Oakes demonstrates his dripless donut dunker, one of the "Postwar Products with a Punch" which he displayed for amusement of members and their guests.

ASTE Needs Your Help in Locating 'Lost' Members

ONE OF ASTE's perennial problems is keeping in touch with its 18,000 members throughout their many changes of address.

The tremendous growth of the Society during the past five years, plus the many dislocations of personnel brought about through the war effort, service in the Armed Forces, and reconversion, have intensified this problem.

Despite the several hundred changes of address reported to the National Office each month, the whereabouts of some 200 members are now unknown to the Society.

Each of these members is losing the services to which he is entitled, because he has neglected to notify ASTE Headquarters, his Chapter or the Postoffice Department of his new address.

To each of these members ASTE is unable to send:

"THE TOOL ENGINEER" — The Society's own official publication which is constantly being improved. The magazine contains an increasing amount of technical data, trade, professional and Society news, as well as sources of tools, machines, materials and services offered by *Tool Engineer* advertisers, which should be available to every member of ASTE.

DATA SHEETS—Technical aid in solving many of the everyday problems confronting tool engineers. The information found in these engineering data sheets is not easily obtainable from any other single source.

A.S.T.E. DIRECTORY—A new annual roster listing members of the Society, their addresses and business connections, together with a cross-indexed catalog of standard machines and tools, a directory of manufacturers serving the tool engineering field, and other important data. This permanent, case-bound, 300-page book is certain to be an indispensable part of every tool engineer's reference library.

INVITATIONS TO NATIONAL MEETINGS—Announcements of the Fourteenth Semi-Annual Meeting, to be held in Pittsburgh, October 10-11-12, will soon be issued. This convention is expected to be the largest Semi-Annual Meeting ever held by the Society, with many prominent speakers participating in the program.

CODE OF ETHICS—An inspirational professional pledge, intended for framing, setting forth the standards, ethics and principles of the tool engineer. This beautifully-printed reproduction, now being mailed, should have a place in the office of every ASTE'er.

NOTICES OF MEETINGS—Notifications of local and national meetings, both regular and special, should reach each member. Therefore, it is important that every change of address be promptly reported to the Chapter Secretary and to National Headquarters.

SPECIAL MAILINGS — A wide range of general information—announcements, policy changes and other important data—is released by the Society at frequent intervals. All of this material is needed by every member in order that he may be intelligently informed of the operation, activities and progress of HIS Society.

You Can Help

Have you moved recently or do you contemplate moving? Then notify your Chapter Secretary and National Headquarters, giving both old and new address.

Have you an ASTE business confrere, friend, or fellow Chapter member who has moved or changed his company affiliation, and who may not see this notice? Do him a good turn by reporting his new address at once.

Are you a Chapter officer or committeeman? It is your responsibility to have any address change information, coming to your attention, forwarded immediately to the ASTE National Office.

To make it easier for you to help the Society regain contact with "lost" members, restoring their many membership services, a change of address coupon is provided on this page. (Additional changes may be listed in the same format on separate sheets.) Mail those new addresses TODAY!

NOTICE OF CHANGE OF ADDRESS

AMERICAN SOCIETY OF TOOL ENGINEERS
1666 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

Member's Name .....
New Street Address .....
City ..... Zone ..... State .....
Chapter ..... Date .....
Company Name .....
Business Address .....
Title or Occupation .....
Old Address Was .....
.....
Information Submitted by .....
(if other than above)
Address .....

Shows Applications Of Crush Dressing

Providence, R. I.—Little Rhody Chapter presented C. J. Linxweiler of the Sheffield Corp., Dayton, Ohio, in a program on "Crush Wheel Dressing," May 15, at Oates Tavern.

C. J. Linxweiler

The subject was well covered in Mr. Linxweiler's talk which was interspersed with slides illustrating the several methods and applications. The audience found Mr. Linxweiler an able speaker, well versed in his subject.

After the talk, many samples were shown of formed parts ground with wheels trued by the crushing method.

Approximately 125 members and guests were present at the meeting. Among the visitors was Ray Morris of Hartford, Conn., ASTE Past President.

WANTED

Clue to identity of group of smiling tool engineers shown at dinner in unmarked photograph received June 24 by *The Tool Engineer*, without indication of sender. Reward: Publication in *ASTE News* with proper credit. Send information to *ASTE News* Editor, *The Tool Engineer*, 1922 W. Canfield, Detroit 8, Mich.

Hard-to-Machine Parts Can Be Precision Cast

Los Angeles, Calif.—C. C. Pendrell, District Manager, Haynes Stellite Co., Kokomo, Ind., presented an illustrated talk on Precision Casting, before a large gathering of members and guests at the May 9 monthly dinner meeting of Los Angeles Chapter.

Mr. Pendrell recommended precision casting for parts so shaped that they are very difficult to machine and for those made of extremely hard and abrasive material.

A color-sound motion picture, "Tooling for Better Internal Grinding," followed. The film is a production of the Bryant Chucking Grinder Co.

Coffee speaker for the evening was W. E. Elieson, Asst. District Manager, United States Department of Commerce, who spoke very dynamically on the place California occupies in the nation's economy.

California, during 1945, had the highest per capita income of any State, he quoted. With the increasing number of heavy industries moving to the Los Angeles area, will come greater opportunities for tool and production engineering, he said.

The steadily mounting influx of manufacturing, he explained, is in anticipation of the enormous potential market of 750 million consumers in the orient, who can be supplied by the United States through the Port of Los Angeles. During March of this year, the speaker added, expansion of industrial establishments exceeded that of any whole year between 1930 and 1939.

Cutting Tool Techniques Described by Daugherty

Racine, Wis.—Cutting tool problems can be solved, if correct speeds, feeds and cutting points are used, Earl W. Daugherty, Tool Engineer from the Chicago office of Whitman and Barnes, told approximately 100 members of Racine Chapter at a meeting May 6 in the Manufacturers Association Building.

Earl Daugherty

Mr. Daugherty, in his talk on the "Proper Use and Care of Drills and Reamers," recommended speeds and feeds for various metals, coolants, and methods of point grinding. He described types of construction incorporated in the making of drills and reamers and the care exercised by the manufacturer.

Laying down fundamental principles that operators should follow in the use of cutting tools, he stressed the necessity for having proper chip clearance.

Drills for aluminum, plastics, cast iron and other materials were discussed, as well as machine and hand pointing.

In the open forum which followed his talk, Mr. Daugherty drew upon his extensive experience in industry, readily answering the many questions from the audience.

Ulrich Explains Design Of Frameless Auto Body

Milwaukee, Wis.—T. E. Ulrich, Chief Body Engineer of Nash-Kelvinator Corp., Detroit, was the principal speaker of the evening at a meeting of Milwaukee Chapter held May 9, in the Elks Club.

Mr. Ulrich's topic, "Unitized Body Design and Development," dealt with the design of the frameless body used on the Nash automobile. Difficulties and engineering changes involved in executing the design were discussed, as well as the advantages of the frameless body. A lengthy query session followed with many members participating.

Second feature of the program was a sound film released by the Elgin National Watch Co., showing various stages of synthetic sapphire used as jewels in precision watches and instruments. The sequences revealed the complete manufacturing procedure from the cutting of the raw material to the packing of the finished jewels in separate containers ready for storing.

K. W. Howard, District Engineer of the Elgin National Watch Co., commented on the film, answering questions from the floor upon the completion of the showing.

A short sports film, entitled "That Boy of Mine" and released by Evinrude Motors of Milwaukee, completed the program.

Coming Meetings

DETROIT—Annual Golf Tournament, July 27, Gowanie Golf Club near Mt. Clemens. Entire club reserved for ASTE members and guests. Buffet lunch will be served, with dinner optional. Prizes.

ST. LOUIS—Outing, July 20.

Situations Wanted

MASTER MECHANIC—46, extensively experienced in automotive production, seeks position as manufacturing executive. Have also served as Engineering Consultant at Moscow, U.S.S.R., and as Technical Advisor to tool company executive. Address Box I, American Society of Tool Engineers, 1666 Penobscot Bldg., Detroit 26, Michigan.

PRODUCTION ENGINEER—47, with 25 years' experience in tool, die and machine design, tool room management, production and cost control, sales and estimating, plant organization and management, wage incentives and methods. Prefer an East Coast location as Tool and Production Engineer or Factory Manager of a medium-sized metal fabricating plant. Write Box H, American Society of Tool Engineers, 1666 Penobscot Bldg., Detroit 26, Mich.

TOOL DESIGNER—Experience includes 4½ years' tool processing, 10 years' machine design and automotive engineering. Prefer tool designing or tool contact work. Address inquiries to Box J, American Society of Tool Engineers, 1666 Penobscot Bldg., Detroit 26, Mich.

Illinois Group Shivers At "Summer Stag"

Rockford, Ill.—On one of the coldest June days ever recorded in local weather history, 125 members and guests of Rockford Chapter braved the frigid breezes to attend the annual "Summer Stag" held on the 1st.

The large fireplace in the pavilion at Svithoid Park, where the outing took place, held a roaring fire throughout the afternoon and evening.

Many of the hardier members and guests, who ventured outside to watch the various contests, saw Fred Kampmeier win the golf contest, Don Hawkinson and George Johnson come off victors at horseshoes, and Frank Oswalt walk away with top honors in the bait casting event.

E. W. Dickett won first prize guessing how many bolts, nuts, screws, and washers were contained in a pint jar.

The West Side "Peaches" (so called because the entire team wore wigs and skirts) finally, after many years, beat the East Siders 11-7 in a closely contested softball game.

Refreshments were served in the afternoon, followed by dinner in the evening. After dinner, Kenneth Lund, acting as Master of Ceremonies, distributed the attendance prizes, assisted by Ernest Seborg.

Hamilton Engineers Hold Dance at Country Club

Hamilton Chapter members, their wives and guests trip the light fantastic to music of a 12-piece orchestra at Annual Spring Dance, May 3, in the Dundas Golf and Country Club, Dundas, Ont. J. N. Walton, Chapter Chairman, assisted by Charles T. Kemp, Entertainment Chairman, was in charge of the event. A large attendance of local and out-of-town members enjoyed the affair.

Reviews Development Of Military Aircraft

Erie, Pa.—Concluding technical session of the current season for Erie Chapter was addressed, May 8, by Samuel Irvine, President of the Aero Supply Mfg. Co., Inc., Corry, Pa., at a dinner meeting in the General Electric Co. Community Center.

Mr. Irvine reviewed the history of airplane development from World War I up to the present time, stressing that in each war it was mastery of the air that gave the Allies the edge.

During the first World War, the speaker served in the British Air Corps, supervising the building of many experimental planes. Some of the crude experiments of that time ultimately evolved as finished products in the high speed fighters and bombers of World War II.

An added educational feature was the showing of the film, "Erie, Gem City of the Lakes," many of the home town industries and historical places pictured being comparatively new to some of those attending.

The presence of C. V. Briner, ASTE Past President, was an unexpected highlight of the evening. Chairman Harold Hagle introduced Mr. Briner who spoke of ASTE's past accomplishments, the New Era Exposition and the Society's plans for the future.

Frank Roach, Chapter Delegate, gave a graphic report of activities at the Annual Meeting and New Era Exposition at Cleveland.

The fall and winter season of the Chapter will open in September with a Ladies Night program, it was announced.

Potomac Chapter members eagerly inspect display of samples exhibited by G. A. Ebelhare of the Synthane Corp., who lectured on "Laminated Plastics" and their applications at a recent meeting.

Plastics Authority Shows Applications

Washington, D. C.—An outstanding technical session was recently presented by Potomac Chapter at the Washington National Airport when G. A. Ebelhare, Superintendent, Synthane Corp., Oaks, Pa., lectured on the development of "Laminated Plastics," with emphasis on their applications.

Mr. Ebelhare took his audience on an imaginary visit through a typical laminated plastics plant, discussing various materials and their relative merits for specific uses. An extensive display of samples was available for inspection.

The speaker, an authority on the fabrication of plastics, is co-author of the National Electrical Manufacturers' Association publication, "Recommended Practice for Fabricating Plastics."

Following the lecture, a sound film was screened, showing the fabrication of laminated plastics.

One hundred and fifty members and guests attended the dinner and technical session.

ASTE Talent Entertains At Dinner Dance

Pontiac, Mich. — Tool engineers of Pontiac Chapter entertained their ladies May 23 at a dinner dance in Waterford Community House.

Entertainment Chairman George Pudduck, the Master of Ceremonies, rendered several solos, and the Rolling Rhythm Quartet, featuring Lyndon S. Salathiel, "The Musical Maestro," also entertained.

Charles Staples, Past Chairman of the Chapter, introduced Claude Osborne and A. J. Rhodes of the speakers' club. The former read a poem concerning a tool engineer, and Mr. Rhodes related his trying experiences in reaching the ASTE Exposition at Cleveland.

Dancing was enjoyed by the approximately 50 couples present.

Industrial Sapphires Made Synthetically

Aurora, Ill.—More than eighty tool engineers, technicians and manufacturers in the Fox River Valley Chapter area learned the story of sapphire in a three-part program at the Chapter's May meeting in Hotel Baker, St. Charles, Ill.

R. F. Waindle

The mystery of crystallography and romance of manufacturing synthetic sapphire was presented by Roger F. Waindle, General Manager of the Sapphire Products Div., Elgin National Watch Co., Aurora.

A series of slide pictures showed the chemistry of growing sapphire crystal; types of crystals and importance of orientation of crystal axis; chemical, physical and optical characteristics; comparative hardness and serviceability; and use of electron microscope in studying both diamond and sapphire.

In his lecture, Mr. Waindle pointed out several pertinent facts concerning the application of sapphire, not only to instrument jewel bearings, but as an engineering material as well.

The speaker said, "Sapphire in its natural state is not available in sizes large enough to meet the requirements of industry. Nor is natural sapphire a dependable material because of its impurities and erratic crystalline structure.

"Faced with the big demand for jewel bearings in the many types of instruments used by our armed forces," he added, "the Sapphire Products Div. of the Elgin National Watch Co. pioneered the development and manufacture of synthetic sapphire on a large scale. More recently they have expanded its field of application into the engineering world. Sapphire is now applied to gages, wear points, micrometer tips and many other uses."

Following Mr. Waindle's talk, a color-sound film was shown depicting the intricate steps in the manufacture of jewel bearings. This film was especially interesting to the average tool engineer who works with carbide or steel cutting tools, dies, fixtures and devices on relatively large castings or forgings, performing work on big machines.

In the process of jewel making, it was shown how this hard synthetic material is cut, formed, and finished into a precision part by the exclusive use of diamond-charged cutting and grinding wheels on lilliputian equipment.

Highlighting the dinner meeting was the presence of National Director-Elect C. B. Cole and Ben C. Brosheer of Chicago Chapter, and National Membership Chairman E. W. Dickett of Rockford.

Retired Tool Engineeress Yearns for Wolf Calls

Detroit, Mich.—The rigors of postwar reconversion from tool designer to the much more difficult assignment (under present conditions) of chief household engineer are amusingly related in a letter from Mrs. Leo Cavanaugh of Detroit, regretfully tendering her resignation from Society membership.

Mrs. Cavanaugh

Mrs. Cavanaugh writes:

"I am a little reluctant in discontinuing my membership in the ASTE as, at one time, I had hoped to remain in the tool design field.

"However, since last October, I have resumed my role as 'essential' woman. I now spend my working hours running a variety of machines — chiefly, mixmaster, vacuum cleaner, washing machine and gas stove.

Sighs Over "Soap Operas"

"Where I once listened to the snappy stories of John, I now hear the sad moans of 'John's Other Wife,' and the brains that once puzzled over the problems of gearing and gages now ponder the question of where to get butter.

"In short, I have exchanged the drawing board for the wash board, not without regret—*I do miss those wolf calls.*

"However, the change in position has had one beneficial effect—I no longer answer my own questions, and less and less frequently talk to myself.

"If there should be in our Dynamic Detroit, one—just one—empty drawing board crying for a slightly rusty tool design detailer, and I hear of it, I shall be glad to reopen my ASTE membership, if I may," she concludes engagingly.

The operation of the domestic machines referred to are "duck soup" for Mrs. Cavanaugh after toiling over the tooling of such equipment as tanks, aircraft, farm and mining machinery during her two and one-half years at Affiliated Engineering, Modern Industrial Engineering, and Engineering Service in Detroit.

But her responsibilities in keeping the culinary assembly line operating give her nostalgia for the relatively simple life of an industrial engineer.

Who has a deserted drawing board to take Mrs. Cavanaugh out of those bread, butter, and meat lines?

Aluminum Bronzes Have Wide Range of Qualities

Williamsport, Pa.—"Aluminum Bronzes and Their Application" was the subject very capably presented by J. P. Henry, Eastern Manager, Ampco Metal, Inc., Milwaukee, Wis., to 45 members and guests of Williamsport Chapter at the Home Dairy Co., May 13.

Mr. Henry described the composition, physical properties and application of these alloys, stating that the aluminum bronzes constitute a series of alloys with a wide range of physical properties.

Applications Varied

These characteristics make them versatile, he added, permitting many applications in which high loads, shock or impact conditions are encountered. In addition, the alloys have high corrosion resistance. Basic elements used are copper, aluminum and iron in varying percentages according to the physical requirements of the alloy.

Aluminum bronze alloys, Mr. Henry pointed out, may be centrifugally or precision cast, extruded or produced by almost any method to the shape required by the designer. Since these alloys are 10-14% lighter than the regular bronzes, they are useful in the aircraft industry as well as in mechanisms where reduction of inertia is desirable.

Because of the high physical strength of these alloys, they can be used in many machine tool applications where wear must be reduced to a minimum to obtain the required accuracy from the machine, the speaker concluded.

Following the talk, the meeting was opened for general discussion of the various points stressed by the speaker.

J. Harold Shafer, the Chapter's delegate to the Annual Meeting at Cleveland, gave a resume of the conclave.

The May Chapter meeting ended the current series of technical sessions, the next gathering of the group being scheduled for September 9.

Graphitic Steel Superior In Tooling for Bearings

Hartford, Conn.—Technical Session, at Hartford Chapter's May 6 meeting in the Hartford Gas Co. Auditorium, featured A. F. Sprankle, Asst. Chief Metallurgist, The Timken Roller Bearing Co., Canton, Ohio.

Mr. Sprankle, in his lecture, "Tool and Die Applications of Graphitic Steels for the Bearing Industry," gave his audience information of great value to tool engineers.

His talk was supplemented with motion pictures, graphs and tools demonstrating the advantages of graphitic steels.

Before the technical session, dinner was served at the City Club, followed with a coffee talk by Roxy Short, Personnel Director for Sikorsky Aircraft Div., United Aircraft Corp., Stratford, Conn. His discussion and the accompanying film enlightened his listeners concerning the performance and future of the helicopter.

Third Vice-President Irwin F. Holland spoke briefly on the procedures issued to all officers of the Society by the Organization Progress and Constitution and By-Laws Committees.

An extensive report of the activities of the House of Delegates was given by Edmond Morancey.

Named General Manager

Stamford, Conn.—Otokar F. Bernardin has been engaged as Production Manager by Aircraft Controls Co., Stamford, according to an announcement by M. Gorn, General Manager.

O. F. Bernardin

In his new position, Mr. Bernardin will take charge of product design and production operations, including engineering.

Previously he was employed by Maguire Industries, Inc., Electronics and Radar Div., Greenwich, as Plant Engineer. Earlier he served both War and Navy Departments as Assistant to Consultant Engineer with the Ordnance Department.

Mr. Bernardin is affiliated with Greater New York Chapter, ASTE.

Technical Groups Hear Willys-Overland Head

Toledo, Ohio — Sixty members and friends of Toledo Chapter, ASTE, attended the Detroit Section, SAE, and Toledo Technical Council April 1 dinner meeting, along with representatives of other member societies.

James D. Mooney, President and Chairman of the Board, Willys-Overland Motors, Inc., addressed the affiliated organizations. His subject was "Economic Forces and Their Influence on the Automobile Industry."

Robert P. Lewis, Chief Engineer, Spicer Mfg. Corp., and Past President of Toledo Technical Council, presided.

The meeting was held in Commodore Perry Hotel, with an attendance of 520.

Annual Spring Frolic Concludes Season

Philadelphia, Pa.—The Annual Spring Frolic and dinner of Philadelphia Chapter, held May 16, was a gala occasion with six Broadway acts presented for the enjoyment of the 210 members and guests present.

Preceding the vaudeville show, an informative film entitled, "Giant Killers," was screened. The pictures portrayed the construction of Navy P.T. boats at the Elco Plant.

A thing of beauty with fine flowing lines from stem to stern, the P.T. boat is probably the most sturdy and seaworthy wooden ship ever constructed. In building this vessel many kinds of lumber from all over the world were assembled with mass production methods, each part being fabricated with machine shop precision.

Built with Keel Up

Her hull was built in a rather unconventional position, with the keel up. This facilitated construction by enabling workmen to perform the various operations without assuming awkward positions.

Righting the ship presented some difficulties, but at the Elco Plant according to the film, this maneuver was performed at lunch time and was made the occasion for a little celebration.

Three high-powered engines driving three screws give the ship a very high velocity. Her terrific fire power, enabling her to destroy an enemy many times larger than herself, inspired her builders to call the P.T. boat, "Giant Killer."

Mr. Osborne, the Master of Ceremonies, amused the group between acts with his tricks of magic. But two of the best performers were Members "Winnie" Weisel and Clarence Duffany who assisted Mr. Osborne.

Philadelphia Chapter members (center) enjoy performance of ASTE'ers "Winnie" Weisel and Clarence Duffany (top, left and right) who assisted "Emcee" Osborne, a prestidigitator, at Annual Spring Frolic, May 16. Impromptu antics of these members throughout the evening "brought down the house." Below is a group at dinner which preceded evening's program of vaudeville and films.

Industrial Leaders Learn Value of Quality Control

Elmira, N. Y.—Industrial Leaders Night was observed May 6 by Elmira Chapter, nearly one hundred members and guests attending the dinner meeting at Mark Twain Hotel.

Immediately after dinner, a dance program was presented by the Elmira College Modern Dance Club.

First Vice-Chairman Edward Stachel introduced the speaker of the evening, Alfred L. Davis, Associate Director of Evening and Extension Div., Rochester Institute of Technology. Mr. Davis gave his address, "Fundamentals of Inspection Procedure," originally delivered at the ASTE Annual Meeting in Cleveland.

The speaker explained the quality control function and its use throughout industry, from receiving to shipping. The Tool Engineer contributes to the speed and accuracy in making precise measurements, he said, as well as to the type of quality maintained within a manufacturing organization.

.00006" Surface Finish Possible

During the course of his talk, Mr. Davis mentioned that one manufacturer had developed a means for producing and measuring, on a production basis, a surface finish of 0.6 of a microinch—adequate testimonial to the extent to which quality control can be carried.

Following Mr. Davis' speech, several members participated in an open discussion concerning various phases of quality control and recent developments for making fast, accurate measurements.

At the conclusion of the technical program, a short sound film on fly fishing was presented for the enjoyment and instruction of the group.

George N. Morceau, Elmira Chapter Delegate to the Cleveland convention, reported on the activities of the first House of Delegates.

Among guests introduced were: Messrs. Whitney, Sutton and Curo, of the Eclipse Machine Div.; Mr. Watkins of Corning Glass Works, James Stanley of New Bedford, Mass.; and Robert Cushman of Syracuse.

Adjournment of the meeting terminated the season's formal program. Meetings will be resumed in September.

Emphasizes Versatility Of Modern "Automatic"

Toronto, Ont. — Speaking before a capacity audience of approximately 200 members and friends of Toronto Chapter, Willard H. Spence, of Brown & Sharpe Mfg. Co., Providence, R. I., presented in a very able manner "Tooling Applications for Automatic Screw Machines," at a meeting May 13 in Malloney's Art Gallery.

W. H. Spence

Thoroughly grounded on this subject, the speaker gave a brief history of the introduction of the Automatic machine to industry. The machine of 1888, it appears, carried the same fundamental principles found in today's modern Automatic. Even at that early date, the machine had a turret and cross slide, Mr. Spence pointed out.

The present Automatic, the speaker stressed, has a remarkable range of speeds and feeds to accommodate all types of metals, including aluminum.

Drilling, tapping and reaming were illustrated and explained, Mr. Spence dealing in detail with special applications and versatile attachments for screw-slotting.

This final meeting of the year drew the largest attendance of the season, with approximately 50 visitors from surrounding towns.

Chairman Walter Appleton, designating his term of office as "Fellowship Year," suggested that members wear identification buttons at meetings to enable them to become better acquainted.

The October meeting, the Chairman announced, is to be "Father and Son Night." Guest speaker will be His Worship Robert H. Saunders, Mayor of Toronto.

Harold Porter, Chairman of the Entertainment Committee, spoke briefly on arrangements for the annual field day at the Elms Golf Club, Weston, Ont.

Eric Crawford gave a summary of the events at the Cleveland ASTE Exposition and convention attended by 167 Canadians, including 70 from Toronto.

Georgia Gains 300 Plants In Year, Says Tech Head

Atlanta, Ga. — Atlanta Chapter was honored at a recent meeting with an address by Col. Blake Van Leer, President of Georgia School of Technology. His topic, "Industrial Georgia," was of particular interest to tool engineers.

Georgia, the speaker asserted, is well on the way toward an industrial revolution. Its former largely farming economy is now becoming an increasingly industrial economy, 1945 estimates showing an industrial income almost three times the agricultural receipts.

During the year beginning September, 1944, more than 300 new industries began operations in Georgia, Col. Van Leer stated, adding that hundreds of firms are now seeking locations in this state. Skilled and semi-skilled workers now number more than three times those residing here before the war.

The State, the Colonel continued, can now finance its own industry without relying on outside capital. Bank deposits of more than one and one-half billion dollars represent an increase of 366% over those at the end of the first World War.

In conclusion, the speaker stressed an increasing need for scientific planning and technique throughout the State.

Following Col. Van Leer's talk, a film, "Magic Wand of Industry," was shown. The motion picture is a Lincoln Electric Co. release.

Leidy With Plastics Firm

Plainville, Conn. — Harold W. Leidy has joined Myler Plastics Corp. as Chief Tool Engineer, according to an announcement by Carl A. Gray, President of Grenby Mfg. Co., makers of precision grinding machines. The plastics firm is an associate company of the Grenby concern.

H. W. Leidy

Mr. Leidy, a member of Detroit Chapter, ASTE, was previously connected with Pioneer Eng. & Mfg. Co., Willys-Overland Motors, Inc., and Goodyear Aircraft Corp.

Cutting Points Sharper On Crush Dressed Wheel

St. Louis, Mo. — Final dinner and technical meeting of the season was held June 6 by St. Louis Chapter at the York Hotel, with a gathering of about 300 members and guests who heard Carl J. Linxweiler, Manager of Machine Tool Distribution, the Sheffield Corp., Dayton, Ohio, outline the historical background of crush grinding from antiquity to the present time.

An important feature of Mr. Linxweiler's discourse was a comparison of a wheel which had been diamond dressed with one dressed by the crush method. Cutting points of the latter were much sharper and more numerous than those on the diamond dressed wheel. This advantage enables the crushed dressed wheel to cut faster, cooler, easier, and longer.

Mr. Linxweiler added that best results had been secured from 18-4-1 high speed steel for the rolls.

Elmira Chapter officers and guests of honor take their places at speakers' table for Industrial Leaders Night dinner, held May 6 at Mark Twain Hotel. Left to right: Ernest A. Folts, Industrial Relations Chairman; Morris T. Whitney, Edward Stachel First Vice-Chairman; Alfred L. Davis of the Rochester Institute of Technology (technical speaker), Floyd B. Allen, Chairman; George N. Morceau, Delegate and Past Chairman; and James F. Deegan, Entertainment Chairman. Below: The members await showing of film on fly fishing presented at conclusion of technical session on Inspection Procedure.

ASTE Know-How Vital to Economic Progress, Executives Told

York, Pa.—"The only answer to mounting costs is greater production per man-hour through better methods and better tools—there is no other way that our present standard of living can be maintained at its present level, and certainly there is no other way to improve it," William J. Fisher, President of the A. B. Farquhar Co., York, declared in his address, "Tools and Their Importance to Our Economy," delivered at the Annual Executives Night dinner recently held by Central Pennsylvania Chapter in the Yorktowne Hotel.

Present developments are a challenge to tool engineers, he asserted, if our industrial establishments are to return to an economically sound basis.

The speaker outlined the development of man and his mental growth through education as a means of using natural resources and labor more effectively to improve his standard of living. Only through a continuance of this fundamental principle, can further progress be expected, he said.

Must Be Practical

Management, too, has a responsibility, he pointed out, in supporting and encouraging tool engineers in their efforts. Tool engineers, on the other hand, should make a reasonable presentation to executive management, justifying costs, estimating savings and the length of time required to make a recommended expenditure self-liquidating.

If such a presentation indicates that the project under consideration is a good business proposition, it is difficult for management to give a negative answer, he added.

"Since production is the master key to our whole economy, the knowledge and experience gained by others and available through ASTE, is important to those who have chosen this profession, if they are to meet the present challenge," Mr. Fisher summarized.

Guests at the function included: B. F. Hantz, Chief Engineer, American Insulator Corp., New Freedom; Frank Symington, President, Brandt-Warner Mfg. Co.; B. T. Root, President, and William Stair, Vice-President, B. M. Root Co.; E. S. Burdick, Superintendent, Snap-On-Tools Corp., Newport; William Noble, Works Manager, York Industries, Inc.

Nearby Plants Send Executives

Henry M. Thornton, Vice-President, Dentists Supply Co.; Paul Gardener, President, Dewalt Products Corp., Lancaster; Raymond Wentzler, Plant Superintendent, York Corrugating Co.; Robert E. Manley, Jr., President, Remco Products Corp.; J. S. Reese, General Superintendent, T. B. Woods Sons Co., and J. G. Harper, General Superintendent, The Wolf Co., both of Chambersburg.

E. J. Newcomer, President, Floorola Products, Inc.; J. B. Sechrist, President, Red Lion Cabinet Co., Red Lion; M. H. Ivins, Secretary, and E. C. Clarke, Jr., Plant Engineer, Chambersburg Engineering Co., Chambersburg; A. T. Morris, General Manager, American Chain Div. of American Chain & Cable Co.; Horace Hoch, General Manager, The McKay Co.

Varied Industries Represented

George Campbell, President, International Chain & Mfg. Co.; James T. Duffy, President, Read Machinery Co., Inc.; Charles Strickler, General Manager, General Machine Works; William H. Ottemiller, President, William H. Ottemiller Co; H. J. Stewart, Asst. General Manager, General Electric Co., York Wire & Cable Div.; Paul J. Rees, Plant Superintendent, S. Morgan Smith Co.

J. G. Bergdoll, General Works Manager, York Corp.; Charles McFall, Chief of Contract Sales, Martin-Parry Corp.; L. H. Brenneman, Vice-President, York-Shipley, Inc.; H. W. Stone, President, York Hoover Corp.; Russell Long, Superintendent, Hardinge Co., Inc.; and B. E. Crispin, President, Multiplex Mfg. Co., Inc., Berwick, Pa.

ASTE First Vice-President W. B. Peirce and Second Vice-President T. P. Orchard, W. W. Berchtold, President, Engineering Society of York; and E. L. Rogers, Chairman, ASME, were also guests at the function.

Central Pennsylvania Chapter was host to leading industrialists in the York area at the Annual Executives Night dinner recently staged at the Yorktowne Hotel. Seated at the speakers' table are, left to right: Preston A. Rickrode, Constitution and By-Laws Chairman; Thomas P. Orchard, Second Vice-President; W. J. Fisher, President, A. B. Farquhar Co. (guest speaker); Walter Ehrenfeld, Education Chairman; W. G. Vernon, Chairman; W. B. Peirce, First Vice-President; W. W. Berchtold, President, Engineering Society of York; and E. L. Rogers, Chairman, ASME. General view below shows part of the audience who heard address, "Tools and Their Importance to Our Economy."

Swiss Scales Calibrated Beyond Millionth of Inch

Boston, Mass.—May meeting of Boston Chapter was held in Schrafft's Restaurant.

Principal speakers of the evening were Carl J. Linxweiler and R. Y. Moss, both of Sheffield Corporation, Dayton, Ohio, who discussed "Crush Dressing of Multiform Grinding Wheels for Reproducing Intricate Forms Accurately, Quickly, and Economically."

R. Y. Moss

C. J. Linxweiler

The gadget talk was given by Ralph I. Robbins of the Submarine Signal Co., Boston, who spoke on "Applications of Permanent Magnets for Tool Engineer Use." His talk demonstrated how backlash could be removed from lead screws by the use of permanent magnets.

Guests were present from Brazil, Mexico, and many parts of the U. S. Among the visitors was Pierre M. Bourcart of the Societe Genevoise d'Instruments de Physique of Geneva, Switzerland. Mr. Bourcart gave an extremely interesting explanation of the manufacture of precision standard scales which are made and calibrated to tolerances beyond a millionth of an inch.

Joseph P. Crosby, Chairman of the Editorial Committee, announced that with the satisfactory establishment of a scholarship in tool engineering at Massachusetts Institute of Technology, the Committee is planning to create similar awards at Northeastern University and Wentworth Institute.

Named Vice-President

Chicago, Ill.—H. M. Taylor has joined Supplies, Inc., Chicago, as Vice-President, according to a recent announcement. The company is a distributor of industrial supplies and equipment in this area.

Active in the cutting tool field for the past 10 years, Mr. Taylor previously was associated with Screw Machine Supply Co. of Chicago.

For five years he served as Treasurer of Chicago Chapter, ASTE, until his election as Second Vice-Chairman in February of this year.

Deadline Nears for Submitting Handbook Data Suggestions

VERY LITTLE TIME remains, Editor Frank W. Wilson warns, for Society members to suggest specific tables, charts and similar material for inclusion in the "Tool Engineers' Handbook."

F. W. Wilson

Data for possible incorporation in the Handbook should be submitted immediately to Mr. Wilson at the ASTE National Office in Detroit, with name and source of the recommended material clearly indicated.

Preparation of the Handbook, Editor Wilson reports, is at the peak of activity with a steady flow of finished manuscripts being handled by the competent Mss. Review Committee.

News to Carry Synopses

As the range and content of each contribution is satisfactorily established, it is planned to release in the *ASTE NEWS* section of *THE TOOL ENGINEER* a thumbnail synopsis indicating the scope of the article.

Additional names of Handbook writers, announced by Editor Wilson, include:

A. BRADFORD REED, whose rise to the top in his company demonstrates the value of production know-how as a lever for advancement to administrative positions.

Following his graduation from Cornell University School of Engineering with the degree of M.E. in 1927, Mr. Reed entered the employ of Rolled Thread Die Co., Worcester, Mass. Beginning as an engineer, he was successively elevated to Superintendent, General Manager, then President and Treasurer, his present offices.

The author of "RTD Thread Rolling Handbook," he has contributed articles on thread rolling to *Screw Machine Engineering, Machinery, Iron Age,* and *Machine Design.* He has lectured on various phases of thread rolling before a number of ASTE Chapters, the Cleveland Engineering Society, and the Tool Panel of the War Production Board Conference in Chicago.

Mr. Reed's affiliations with technical societies include Worcester Chapters ASTE and ASM, and Worcester Engineering Society.

* * *

A veteran of over 20 years with The Lincoln Electric Co., Cleveland, Ohio, G. G. LANDIS, Vice-President and Chief Engineer, received his electrical Engineering education at Ohio State University, graduating with a B.S. degree in 1921.

Began in Laboratories

Two years with several large electrical companies preceded his connection with the Lincoln laboratories in 1923. Seven years later he was promoted to Chief Engineer.

Vice-President Landis is a director of the company and has complete charge of the design and production engineering on welding equipment maufactured by the firm.

Many patents on both arc welding equipment and electric motors have resulted from his genius in the electrical engineering field. In addition to contributing articles to trade magazines, he frequently lectures at colleges and schools.

Mr. Landis is a member of the honorary engineering society, Etta Kappa Nu, belongs to Sigma Xi scientific honorary society and The American Welding Society.

* * *

Among the responsibilities falling to C. E. SMITH, Chief Electrical Engineer, The Taylor-Winfield Corp., Warren, Ohio, are the direction of the Customers' Sample Laboratory, the Research Laboratory, and all routine electrical engineering problems.

Manages Electronic Program

These duties include supervision of the extensive program maintained by his company in the design and development of special electronic controls and a continuous study of welding problems.

A. B. Reed

G. G. Landis

Before beginning his association in 1941 with Taylor-Winfield, manufacturers of resistance spot, seam and butt welders, Mr. Smith completed five years' service with the Westinghouse Electric Corporation, Electronic Section, as Design and Development Engineer, concentrating largely on resistance welding controls.

His papers on Resistance Welding and Controls have been published in related trade magazines over a period of eight years, and he has lectured throughout the country on these subjects.

Has Many Affiliations

Mr. Smith's activities in professional organizations include membership in the American Welding Society, the Electrical Committee on Welding Machines, AIEE; American Society for Testing Materials, Welding Research Council—Projection Welding Sub-Committee; RWMA Electrical Standards Committee, and Acting Member, RWMA-NEMA Correlating Committee.

* * *

From the day that he made a windmill with the staves of a sugar barrel, attached a coffee grinder and successfully cracked the corn for stock feeding at his boyhood farm home in the then territory of Dakota, tool and machine design have been the greatest happiness of ARTHUR A. SCHWARTZ, Chief Tool Research Engineer, Bell Aircraft Corp., Buffalo, N. Y.

The life of this well-known engineer-inventor reads like a novel of frontier days—the family exodus from Chicago, following the notorious Haymarket strikes, to "free Government land" in the illimitable prairies, the sod house built in country frequented by buffalo hunters and harrying Indians, and the disastrous prairie fire in 1889 which reduced the Schwartz menage to the overalls and homemade shirts which they were wearing.

Young Arthur's rudimentary education was acquired at home during the six-month long winters, under the tutelage of a brother who taught school.

Sets Out to See the World

The frustration of youthful ambition through the alternating six months of never-ending, hard-driven toil and confined pointless idling, as well as fireside tales of the wonders of the great city of Chicago, led to his unannounced leave-taking from the family hearth. Fear of the woodshed and pride of achievment combined to delay his return for more than twelve years, until he was the possessor of a B.S. degree from the University of South Dakota, a slim bank roll and a wife.

His mechanical bent served to finance his college course with such jobs as building and repairing bicycles and tending the town's generating plant.

Vacation employment with the U. S. Geodetic Survey gave him a taste for ocean travel and adventure among the widely-spaced islands of the Pacific, subsequently whetted by military service in the Cuban war.

Has Maritime Misadventure

Another thrilling experience occurred while working his passage to Alaska to join the Klondike gold rush, when the steamer grounded on a sandbar, necessitating transfer of cargo in mid-sea.

Building and installing candy making and wire working machinery in California and setting up and servicing large gas engines in Mexico, preceded road construction supervision, machine shop and garage ownership in Buffalo, with varying vicissitudes of fortune.

A. A. Schwartz

C. E. Smith

After several industrial ventures and connections, Mr. Schwartz became associated with Bell Aircraft nine years ago as inventor, designer and estimator of machines, tools and tooling.

Prolific Inventor

Outstanding among his many successful inventions are a machine for making double-pointed tacks, the famous Farnham leading edge rolls, the friction saw, a new type of rivet squeezer, the automatic thread miller for BX ends, spar millers, automatic, precision countersinking machines, and seven radically different automobiles.

He has written for leading technical publications and has addressed ASM, ASME, ASTE, and the War Production Council on widely varying engineering subjects. In addition to his membership in Buffalo-Niagara Frontier Chapter of ASTE, Mr. Schwartz belongs to the Photographic Guild of Buffalo and the United Spanish War Veterans.

Electric Units and Their Relation to Measurement

2nd of Two Parts

By measuring the strength of magnetic fields and determining and comparing E. M. Fs. and currents by the ergs of work done in creating them, a volt or an ampere can thus be definitely created. The reproduction of standards of measurement is assisted by the following facts: (a) The resistance of a conductor kept at a constant temperature is found to depend only on its length and area of cross section, so that standards of resistance are easily reproduced.

(b) The current from certain primary batteries is found to be constant when their terminals are connected by the same wire: Since current and resistance are constant, the voltage of such cells must be constant, and this voltage once determined by comparison with absolute volts as determined above, we have at once a practical concrete standard of E. M. F.*

(c) It is found that the decomposition of an electrolyte, by an electric current, always results in the separation or deposit of exactly equal quantities of the constituents of the electrolyte for equal quantities of current. The deposit in a certain time, being weighed, serves as a very accurate measurement of the amount of electricity which passes in that time, and consequently affords a very accurate means of comparing electric currents. When 1 ampere (determined as above) is passed through a given electrolyte, the weight of material deposited gives us at once a practical standard of current.

On account of the relation $I = E/R$ (1) between amperes, volts, and ohms in a circuit, if any two of them are known the other is also known, so that only two measurements of concrete units are required. The question of which two should be selected and the exact form that each should take has been the subject for discussion at a number of international conferences, the latest of which has recommended that only two electrical units shall be chosen as fundamental units, viz., the international *ohm* defined by the resistance of a column of mercury, and the international *ampere* defined by the deposition of silver.

The *volt* to be defined as the E. M. F. which produces an electric current of 1 ampere in a conductor whose resistance is 1 ohm. Different methods of measurements produce slight differences in the values of the standards, but the values recognized by law in the United States are as follows:

The *standard* (international) *ohm* is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice—14.4521 grams in mass—of a constant cross-sectional area, and of a length of 106.3 centimeters. The *standard* (international) *ampere* is the unvarying current which, when passed through a solution of nitrate of silver in water in accordance with certain specifications, deposits silver at the rate of 0.001118 of a gram per second.

As previously stated, a volt is the E. M. F. which, if steadily applied to a conductor whose resistance is 1 ohm, will produce a current of 1 ampere; but a concrete standard for the volt is also recognized by law, it being specified:

That the electrical pressure at a temperature of 15° centigrade between the poles or electrodes of the voltaic cell known as Clark's cell, prepared in accordance with certain specifications, may be taken as not differing from a pressure of 1.434 volts by more than 1 part in 1000. The latest international conference has recommended the adoption of the Weston cadmium cell as preferable to the Clark for a standard cell. The Weston cell has an E. M. F. of 1.018 volts at 20° C.

*E.M.F. = *electromotive force.*

Standards Insure Uniform Values

Standard resistance wires having a known ratio to the legal ohm are made, and these, with standard cells, are used for calibrating *volt meters* and *ammeters*, which are the names given to the galvanometers for indicating automatically the E. M. F. and current in any circuit. In this way electrical values are made uniform throughout the country.

In addition to the *volt*, the *ampere*, the *ohm*, the *watt*, and the *joule* other practical units have been adopted, the most important of which, for our purposes, are:

Coulomb. The unit of *quantity*, the *coulomb*, which is the amount of electricity passing any point in a second when 1 ampere is flowing in the circuit.

Farad. The unit of *capacity*, the *farad*. A condenser is said to have a capacity of 1 farad when 1 coulomb of electricity will charge it to a potential of 1 volt.

(Potential and E. M. F. are in some senses identical, one being the passive and the other the active state. An E. M. F. is the result of difference of potential.)

If this definition were in terms of the absolute units, that for capacity would read:

A condenser is said to have unit capacity when one unit of electricity will charge it to unit potential.

Since by definition a condenser has a capacity of one *farad* when one-tenth of the absolute unit of electricity charges it to a potential of 100,000,000, a farad must equal $1/10 \times 1/100{,}000{,}000 = 10^{-9}$ absolute units of capacity.*

**When quantities are dealt with having a large number of ciphers either before or following the significant figures it is convenient to express them as multiplied by some power of ten, i.e.,* $10 = 10^1$, $100 = 10^2$, $1/10 = 10^{-1}$, $1/100 = 10^{-2}$, etc.

Henry. The unit of *self-induction*, the *henry*. A circuit is said to have a self-induction of 1 henry when, if the current in it is varied at the rate of 1 ampere per second, the induced E. M. F.—that is, the counter or reacting E. M. F.—tending to oppose the change is 1 volt. The definition of self-induction in terms of the absolute units would be:

A circuit is said to have unit self-induction when, if the current in it is varied at the rate of one unit per second, the E. M. F. of self-induction is unity.

Since by definition a circuit has a self-induction of one henry, when, if the current is varied at the rate of one-tenth of unit current per second the absolute E. M. F. of self-induction is 100,000,000 such a circuit would have an absolute E. M. F. of self-induction 10 times as great, or 1,000,000,000, if the current instead of being varied at the rate of one-tenth unit per second were varied at the rate of one unit per second. Therefore the unit of self-induction, the henry, is equal to 1,000,000,000 = 10^9 absolute units of self-induction. By agreement among electricians self-induction is represented by the letter L; capacity, by the letter C.

Systems Bridged By Speed of Light

Self-induction, when expressed in terms of the fundamental units of length, mass, and time, has the *dimensions* of a length, and the practical unit of self-induction was formerly called a quadrant on account of the fact that in the metric system, an earth quadrant—i.e., the distance from the equator to the north pole = 1,000,000,000 centimeters, and since the henry = 1,000,000,000 absolute units of self-inductance, it was said to = 1,000,000,000 centimeters. In this notation a millihenry = 1,000,000 centimeters.

The *units* which have been considered in this chapter have been derived from the relations between electric currents and magnetic fields and are called *electro-magnetic units*. Another system of units, also based on the centimeter, gram, and second, called *electro-static units*, is in use. The relation between the absolute units of quantity in the two systems is the velocity of light in centimeters per second. This velocity is 30,000,000,000, or 3×10^{10} centimeters per second, and the electro-magnetic unit of quantity = 3×10^{10} electro-static units.

The coulomb, being one-tenth of the absolute unit, = = 3×10^9 electro-static units. The electro-magnetic unit of potential is 1/300 of the electro-static unit. In both systems a condenser is said to have unit capacity when unit quantity of electricity charges it to unit potential.

From the definition of a *farad*, the quantity of electricity in a condenser equals in coulombs the potential in volts multiplied by the capacity in farads, or Q = EC, $\therefore C = Q/E$. Substituting for Q and E their unit values in Electro-static units given above, $C = 3 \times 10^9/1/300 = 9 \times 10^{11}$, or the practical electro-magnetic unit of capacity is 9×10^{11} times as large as the electro-static unit.

The capacity of spherical bodies is found to vary as their radii, and in the electro-static system a sphere of 1 centimeter radius has unit capacity; therefore the capacity of a sphere may be expressed by its radius in centimeters, and capacities are still expressed by some writers and manufacturers by the radius in centimeters of the equivalent sphere. A condenser having a capacity of 1 farad has a capacity equal to that of a sphere having a radius of 9×10^{11} centimeters.

A microfarad (= 10^{-6} farads) is equal to a capacity $9 \times 10^{11} \times 10^{-6} = 9 \times 10^5$, or 900,000 centimeters in electro-static units. The earth's radius is approximately 65×10^7 centimeters; its capacity should be approximately 700 microfarads.

This difference in nomenclature is very confusing, but it exists particularly with reference to the two qualities of self-induction and capacity with which wireless telegraphy is intimately concerned. However, the relations here given—1 millihenry = 1,000,000 centimeters electro-magnetic units; 1 microfarad = 900,000 centimeters electro-static units—will enable one set of units to be converted into the other.

The entire system of units used in electrical measurements is a monument to the ingenuity of scientists, but productive of many difficulties to students. Careful study is necessary.

While the volt, the ampere, and the ohm are really practical units, the farad and henry are too large for practical use.

It would take a very large condenser to have a capacity of 1 farad and a coil of many turns to have a self-induction of 1 henry. Subdivisions of the farad and henry are in practical use.

Multiples and subdivisions of the other units are also frequently used, and for this purpose the prefixes kilo, meaning 1,000; mega, meaning 1,000,000; milli, meaning 1/1000, and micro, meaning 1/1,000,000, are added to the units, and such terms as: 1 kilowatt = 1,000 watts; 1 kilovolt = 1,000 volts; 1 megohm = 1,000,000 ohms; 1 millivolt = 1/1,000 volt; 1 milliampere = 1/1,000 ampere; 1 millihenry = 1/1,000 henry; 1 microfarad = 1/1,000,000 farad; 1 microsecond = = 1/1,000,000 second are in common use. The most common practical units of capacity and self-induction (the qualities of electric circuits with which wireless telegraphy is principally concerned, because they determine the period of vibration) are the microfarad and the millihenry, but even these are too large for convenience.

The terms mil, meaning 1/1000 inch; micron, meaning 1/1,000,000 meter; circular mil, meaning area of cross section of a wire having a diameter of 1/1000 inch, are also in general use among electricians. The E. M. F. (volts) in any circuit connected with a dynamo depends only on the rate of cutting of lines of force (strength of field and rate of revolution).

The *resistance* (ohms) in any circuit depends only on the material, cross section, and length of the conductor forming the circuit. The *current* (amperes) in any circuit depends only on the E. M. F. and the resistance in the circuit. The *power* (watts) in any circuit depends only on the E. M. F. and current in the circuit.

The *self-induction* (henries) in any circuit depends only on the shape and length of the circuit, on the magnetic permeability of the material surrounding and inclosed by the circuit, on the amount of this material and on the position of the circuit relative to other circuits.

The *capacity* (farads) in any circuit depends only on the shape and area of its surface, on the electric permeability of the material surrounding the circuit, on the amount and location of this material (the dielectric), and on the position of the circuit relative to other conductors. (Straight wires are said to have distributed inductance and capacity, coiled wires have concentrated inductance, and condensers have concentrated capacity.)

The *coulombs* in a charged condenser or circuit depend only on the capacity and potential of the condenser or circuit.

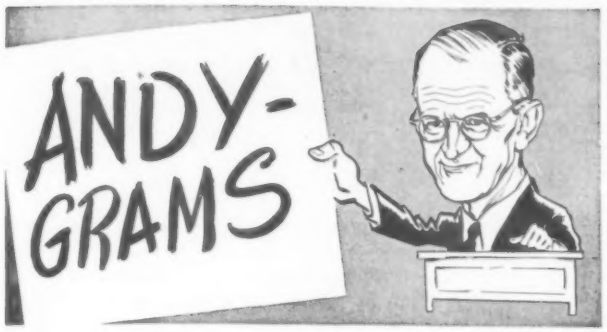
Conclusions

From the foregoing we can make up a table of values as follows:

A volt = 100,000,000 = 10^8 absolute units of E. M. F.; an ohm = 1,000,000,000 = 10^9 absolute units of resistance. An ampere = 1/10 = 10^{-1} absolute units of current.

A watt = a volt × an amp. = $10^8 \times 10^{-1} = 10^7$ absolute units of work per second = 1 joule per second = 1/746 H. P. = 0.737 foot-pounds per second.

A horsepower = 746 watts. A kilowatt = 1000 watts. A farad = 1/1,000,000,000 = 10^{-9} absolute units of capacity. A farad in electro-static units = 9×10^{11} centimeters. A microfarad = 1/1,000,000 farad = 10^{-15} absolute units of capacity. A microfarad in electro-static units = 900,000 centimeters. A henry = 1,000,000,000 = 10^9 absolute units of self-induction. A millihenry = 1/1000 henry = 10^6 absolute units of self-induction. A millihenry in electro-magnetic units = 1,000,000 centimeters.



USUALLY, I wake up singing, to the discomfort of all and sundry within earshot although, with me, it's just a case of bubbling spirits demanding expression. (As a singer, I rate zero.) This morning, however, the lute(?) of Orpheus failed to stir a responsive chord. Instead, I woke up nursing a peeve a/c, for a bedtime story, I'd picked an article by one of these super-futurists who contend that nobody's interested in the doings of yesterday.

The heck they ain't! At the recent Golden Jubilee of the automotive industry, a million people, more or less, jammed downtown Detroit for a neck-stretch glimpse of the ancestors of the modern motor cars. And, throughout the land, untold millions avidly read about everything published about the genesis and development of the automobile. You bet they were interested!

Like the most of us who have worked at this game of tool engineering, I've done my bit to shape the future, even as our forebears did their bit to shape the present. Perhaps they might have done a better job—a debatable point—although, like ourselves, about all they had to build on was the experiences of the past, plus vision and faith. If the structure is good—and it is, in industry, engineering and the sciences—it is because they built on a solid foundation resting on the bedrock of past experience. Like the pyramids of Egypt; beneath the shifting sands that surround them is solid substance that has kept them true throughout four millennia.

Events of past ages can make the headlines. A *nova*, bursting into brilliance in the sky, belatedly tells of a stellar explosion that occurred eons ago. Yet, it's news! The discovery of a Pharaoh's tomb, or a buried city, or of dinosaur eggs or the skeletal vestiges of long extinct fauna not only makes "good reading" for masses of interested people, but draws scientists from the once far but now narrowing reaches of the world.

On these things of the past, be they written in the firmament, in recorded history or on enduring rock, science predicts the shape of things to come—and, ofttimes, shapes them. Thus, in the slow advance of the science of astronomy, there has been evolved a system of time that synchronizes the world to the split fraction of a second. Through study of weather conditions and precipitation, over a period of years, shipping is warned of storms, and public utilities—as hydro-electric plants—lay in supplies of coal to bridge a shortage of water power.

No, we can't ignore the past; should we do so, we would blind ourselves to the present and be left without vision for the future. Nor could we ever make and hold a friend, who, once gained, had his being in the past. As for me, "I will life up mine eyes to the hill" (of tomorrow) the while planting my feet on solid terra firma. For to my way of thinking, the arch reactionary is the futurist who can't see either past or present; for him, the *lethe* of total amnesia.

As a people, we have made remarkable advances in science and engineering, but have lagged deplorably in the social and political fields. We haven't learned to live with one another—haven't learned "good neighborliness." And largely, because we haven't taken the time to delve into the histories of the peoples with whom we have to share this dwindling world. Yet, the world is full of good neighbors. We've some 18,000 here in the A.S.T.E., and we're good neighbors with engineering societies here and abroad.

Take my next door neighbor, for example—a really swell guy! For several years, I've been trying to buy a non-corrosive, pressure garden sprayer, the while waging a nip and tuck battle against insect pests with tin gadgets that rusted faster than I could solder the holes. One evening, however, I came home to find my trees all covered with Bordeaux a/c my neighbor had got himself a gun and had included mine along with his own.

Oh, I may have done him a favor now and then, although I don't keep tabs on those things. But, I've a raft of tools, to which he is welcome when needed, and, being of a mechanical bent, I lend him a hand now and then. And we swap plants and experiences, and there's a gate between our yards—no tariff barriers. But as for that, I've had good neighbors wherever I've lived. The world is full of fine people.

From one thing to another, I journeyed to Madison, Wisconsin, the other week, the occasion being a preview of Gisholt Machine Company's new machine for balancing and correcting automotive crankshafts. Taking a night train, I woke up at break of dawn, and laid there in my berth, taking in the scenery.

Here a meadow, white with daisies, there broad stretches golden with correopsis. Inquisitive crows exploring a newly planted field and, far up, a kingbird harassing a hawk—the second time that I've witnessed one of these unequal aerial battles. A dog barking at a skunk—and up goes the flag! Whoosh! Like a lot of us tool engineers, the pooch had to learn the hard way.

From station to station, in Chi, via one of the Windy City's rattling good taxicabs, then, the Milwaukee Road through the lush Wisconsin dairyland. They built well, the pioneers who settled that region, created a fairyland in which a replica of the leaning tower of Pisa, along the skyline, seems rather incongruous.

Capitol of Wisconsin, and situated on an isthmus between two lakes, Madison is a beautiful town with hills, one-way traffic and strict pedestrian control. An imposing university towers above nice homes. It's a good place to live and a swell vacation spot although you'd better write the Chamber of Commerce about accommodations.

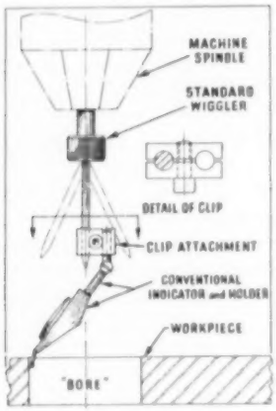
Was met at the station by John Sammis, adv. mgr., who took me to lunch. There, I ran into U. S. James, ol' time ASTEer, and Werner Senger, mgr. of the Gisholt Balancing Machine Div'n. Then to the plant, to view the *machine*—a really fine work of engineering. But, you can read about that in the editorial section, this issue. The machine was demonstrated by Don Zimmerman and John Goggin, both Gisholt engineers with plenty of know-how. During my visit, met George M. Class, vice prex in charge of engineering, and a fellow ASTEer, and E. L. Hemingway who has been doing things with superfinish that's worth a long story. It was really a nice visit, to be long remembered.

Andy

GADGETS

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Attachment to Find Centers



THE ATTACHMENT shown is easily made and very useful, when combined with an indicator and wriggler, for finding centers of bored holes. The idea is not claimed to be new; it's just that the simple clip is so much less expensive than commercial clips.

It is made from rectangular C.R.S., drilled and reamed to fit the bars of the wriggler and indicator, then split, drilled and tapped for the clamp screw. Its use is indicated in the drawing.

Frank J. Peragine — *Greater N. Y. Chapter, A.S.T.E.*

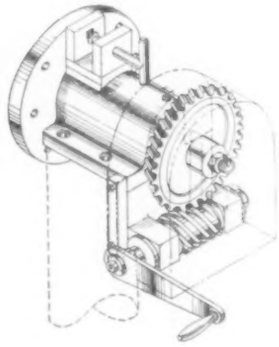
Trunnion Welding Fixture

ONE OF THE GREATEST problems involved in the design and construction of the larger jigs or fixtures is the matter of acquiring a workable indexing mechanism, which will permit operators to vary the position of the work so that it will be within easy reach at all times.

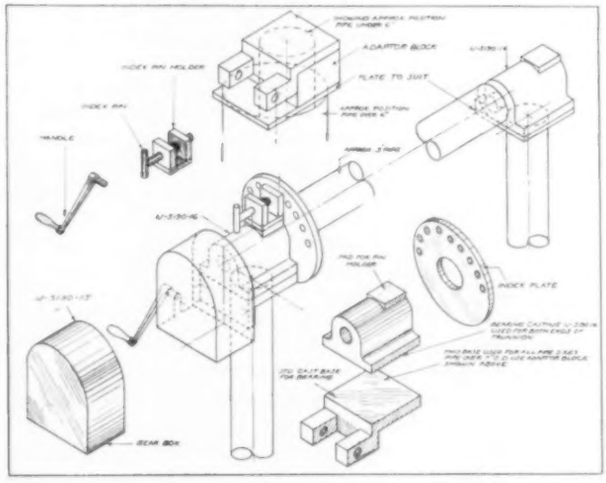
Accompanying illustrations indicate the design of a trunnion which has satisfactorily solved this problem in connection with many of the assembly tools that have been used by Consolidated Vultee Aircraft Corporation. It is a screw-type mechanism which will permit the locating members of a jig to be rotated 180 degrees without difficulty. An index plate and a spring-actuated pin stop make it possible to position the work at any convenient angle in the plane of rotation.

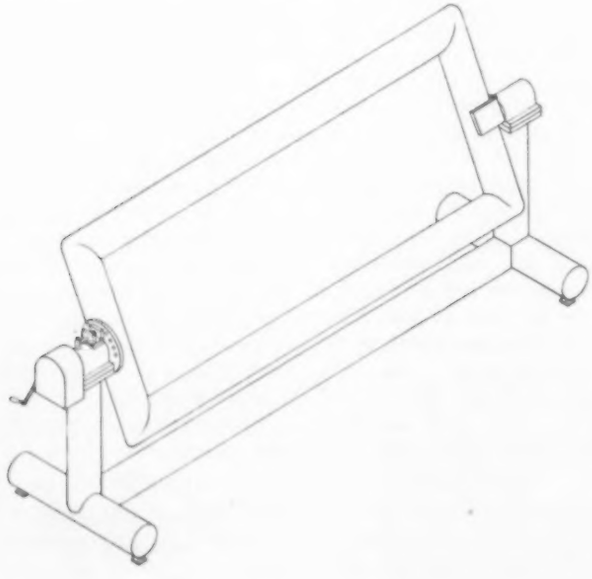
All parts of the mechanism are of steel, and do not have to be machined to extremely close tolerances. Fittings for the trunnion illustrated were made so as to permit use in connection with oil-well casing structures. However, they could be readily altered for use in connection with other types of structures.

The screw-type gearing is desirable in most cases, because it is economical and can be readily operated by a single worker. However, it can be replaced by hydraulic actuating cylinders when extremely large jigs and delicate work must be handled.



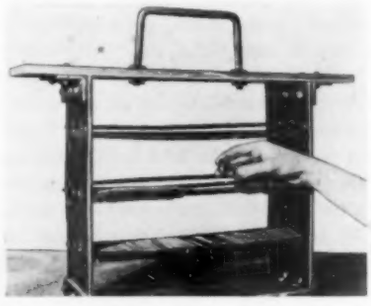
Thomas A. Dickinson
Los Angeles, Calif.





Micarta Dipping Rack

Metal dipping racks, when used in connection with acid cleaning baths for small parts, such as the punchings shown in the photo, are subject to constant repair and replacement due to corrosion. A Micarta rack, used at the East Pittsburgh works of Westinghouse, has out-lasted the heavy brass rack it replaced several times; besides, its inherent lightness makes it much easier to handle. Although brass rods have been used to tie together the model shown, Hipernik will be used in the future because of its greater resistance to corrosion.



GOOD READING

A Guide to Significant Books and Articles of Interest in the Trade Press

In **TRANSLATING INVENTIONS INTO MARKETABLE PRODUCTS**, by S. Bertrand Barnard, in June *Product Engineering*, the author includes this practical suggestion: Early in the development of any invention, the inventor should ask himself whether his invention is an improvement over other devices on the market, or whether it is merely a costlier and slower way of doing something that has already been done before.

If the invention is new, or faster, or less expensive than existing products, the inventor is wise if he then pre-tests his product for customer acceptance. The author believes it may lead to important changes in the invention before final plans are completed, and may ofttimes save considerable expense.

In the same issue, **DISPLACEMENT CORRECTION FACTORS FOR ROTARY SPUR GEAR PUMPS**, by W. B. Erichson, discusses the effect of tooth clearance, tooth space volume, backlash and pressure angle on pump displacement; and also develops values of correction factors for a simple general displacement equation.

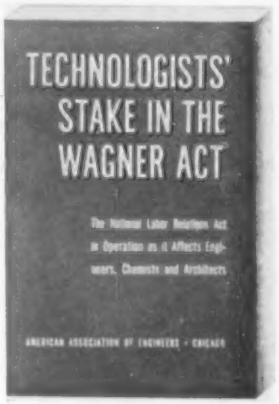
SAPPHIRE AS A PRODUCTION TOOL, by Roger F. Waindle, in the June 6, *American Machinist*, points out that sapphire synthetics have distinct advantages because they can be produced to a purity and in controlled sizes and forms not found in nature. Many sapphire applications are mentioned, including use in dial-indicator points, comparator and micrometer anvils, gage backstops and gage points. The article concludes that although sapphire has many uses today, there are many more coming.

EQUIPMENT DESIGNED TO FACILITATE THE USE OF DIAMOND TOOLS, by Dr. G. Schlesinger and Dr. D. F. Galloway, in June *Machinery*, describes and illustrates a special boring-bar for diamond tools, recently developed by the British Institute of Production Engineers, which includes provisions for adjusting rake and facet orientation. Two other new pieces of equipment mentioned include a diamond-tool holder designed to provide means for easily adjusting side and back rake of tools, and a boring-bar specially built to permit adjustment of tool height.

Also, in the same issue, **A USER ENUMERATES FUTURE REQUIREMENTS FOR MACHINE TOOLS**, is a summary of 10 requirements for future machine tool design. The requirements, made in a speech delivered by J. R. Weaver* at the Machine Tool Electrification Forum held during April at Pittsburgh, are as follows: (1) Machines should be compactly designed. (2) Machine tools must supply more skills formerly needed by the operator. (3) Increased use of electrical motor or control applications are necessary. (4) Still further accuracy is vital. (5) Improvement needed in the means for inspecting and measuring work. (6) More sturdily built machines will be required. (7) Increased use of special construction materials predicted. (8) Further reductions necessary in set-up time. (9) More special purpose tools are needed. (10) The ideal machine of the future, concluded Mr. Weaver, may perform all operations on any piece of work on one machine.

**Past President, A.S.T.E.*

TECHNOLOGISTS' STAKE IN THE WAGNER ACT, first published in 1944, is still a timely presentation of the threat to technologists of absorption into heterogeneous unions. The 273-page book can be ordered from *The American Association of Engineers*, Book Dept., 8 So. Michigan Ave., Chicago 3, and costs $2.00 in paper cover, or $4.00 in the library Fabrikoid edition. It shows how the decisions and reports of the Nat'l Labor Relations Board have affected engineers, chemists and architects.



PRECISION METAL PARTS PRODUCED BY ELECTROFORMING, by H. R. Clauser, in July *Materials & Methods*, describes electroforming as actually a kind of electroplating which uses metals like iron, copper, nickel, and sometimes chromium, to produce parts requiring exceptional smoothness and high dimensional accuracy.

Electroforming uses a master pattern, of the part, to produce a die or mold. This mold, in turn, is employed as the base for electrodeposition of metal. The matrix is placed in an electroplating bath and after the metal has been deposited to the required thickness, the matrix is removed from the bath and separated from the electrodeposited metal. Electroformed iron, for example, is virtually free of porosity—less porous, tests show, than a piece of glass.

NEW LAYOUTS QUICK—WITH MAGNETIC TEMPLETS, is a well illustrated, staff-written article in June *Factory Management and Maintenance*, describing the technique for making plant layouts using magnet-cored plastic templets. Once placed on a plastic mat that is backed by a metal plate, the templets stay put without stapling or cementing.

ARE WE BECOMING A "HAVE-NOT" NATION? by A. Wyn Williams, in June *Mill & Factory*, questions the statement made by Harold Ickes, shortly before he left the office of Secretary of the Interior this spring, when Mr. Ickes said: "The prodigal harvest of minerals that we have reaped to win this war has bankrupt some of our most vital resources."

The author, however, views the situation less pessimistically, and uses figures to support his contentions. He shows, for example, that our natural oil supply can be prolonged, at the present level of consumption, for at least 350 years by improved shale rock extraction. A still more favorable situation holds for iron. With improved techniques, as applied to recovery of low-grade ore, there is enough to last for 5000 years at the present rate of consumption.

BULLETINS AND TRADE LITERATURE

Items briefed herein have been carefully selected for their interest and application. Unless otherwise stated, all are available, free, from the stated sources.

Guide to Everyday Welding, and Wall Chart DH-1314, are two releases of **PAGE STEEL & WIRE DIV.** of American Chain & Cable Co., Inc., Monessen, Pa. The wall chart gives chemical and physical properties of Page welding electrodes and gas welding rods; while the guide makes for easy selection when welding various types of materials, structure and equipment.

A 98-page illustrated catalogue—*Valvair Air Control Valves*—by **VALVAIR CORP'N**, 454 Morgan Ave., Akron 11, Ohio, describes valves developed by the company for continuous hard service, and includes prices of all models. Designed for pressures of 200 psi, and temperatures to 120 degrees F., Valvair 2, 3, and 4-way valves are available in manual, cam, foot and diaphragm operation in standard pipe sizes from ¼" to 1".

Work Done on the Blanchard is a 77-page catalogue of the flat surface grinding machines made by **THE BLANCHARD MACHINE CO.**, 64 State St., Cambridge 39, Mass. Their smallest machine is No. 11—a surface grinder with 11" wheel, 16" magnetic chuck, and 15 hp motor on spindle. Many other sizes are shown, including their largest surface grinder—No. 27—with wheel sizes from 27" to 42", magnetic chucks 48" or 60". An extension ring, 84" or 96" in diameter may be added for increased range.

The Red Ring Universal Gear Checker, a bulletin by the **NAT'L BROACH AND MACHINE CO.**, 5600 St. Jean, Detroit 13, illustrates equipment for checking index or tooth spacing, in gears, and many other factors including helix angle, eccentricity, tooth size and parallelism.

MEEHANITE METAL CORP'N, New Rochelle, N. Y., has issued a folder—*Form DM-145*—describing typical casting case histories, including thread gages, upsetting dies and precision machinery applications. The folder also illustrates 12 other Meehanite industrial bulletins available.

Rust Prevention, a 40-page publication of the **SHELL OIL CO., INC.**, 50 W. 50th St., New York City, states the basic facts on rust formation and lists the many Shell Ensis products available. Two charts, and several color photographs of test plates are included.

Wade Hand Screw Machine, a booklet of **THE WADE TOOL CO.**, 49 River St., Waltham 54, Mass., lists advantages of two hand screw machines — Model No. 5, ¾" collet capacity; and Model No. 7 with 1" collet capacity. The spindle speeds of both models, in ratio of 4: 1, are 315, 515, 825, 1270, 2065 and 3300 rpm. The machines are especially designed for second operation work, or work which can be chucked individually.

"Surface" Prepared Gas Atmospheres, issued by **SURFACE COMBUSTION CORP'N**, Toledo, supersedes a less extensive discussion of prepared atmospheres included in a previous bulletin.

Catalogue No. 9 of **THE PRODUCTO MACHINE CO.**, 3017 Medbury, Detroit, is a 96-page listing of prices and specifications of their die sets and accessories for tool and die makers and users of power presses.

AMERICAN WELDING & MFG. CO., Warren, Ohio, has issued a bulletin *Motor Frame Welding*—describing arc and flash welding in the manufacture of simple ring and complex specialized frames for A-C and D-C motors of either fractional or integral horsepower.

In *Bulletin 194-SA*, the **CAMBRIDGE INSTRUMENT CO., INC.**, 3113 Grand Central Terminal, N. Y. 17, describes their line of roll, extension, mold and needle pyrometers, developed to meet the demand from many industries for accurate checking of temperatures of working surfaces.

A revised catalog—*No. 845*—by **SIMMONS FASTENER CORP'N**, N. Broadway, Albany 1, N. Y., features Simmons Quick-Lock and Spring-Lock fasteners, as well as their Dual Purpose Safety Nut, all of which can be used in a wide range of industrial and consumer products.

Tool-Flex is a recent leaflet of the **BURG TOOL MFG. CO.**, 6709 S. San Pedro St., Los Angeles 3, announcing their complete line of flexible tool holders for every type of service, regardless of shank or collet required.

HARDINGE CO., INC., York, Pa., has issued *Bulletin No. 45* on their BLM "Auto-Centri" clutch, available from fractional to 5000 hp for any type of power drive. Hardinge recently obtained manufacturing and sales rights for the clutch from Automatic Clutch Corp'n of Canada, a subsidiary of British Meter Company.

Bulletin 520, a 14-page spiral ring publication of the **ROCKFORD MACHINE TOOL CO.**, Rockford, Ill., lists advantages of the Rockford Hy-Draulic Openside Planer with hydraulic drive to table and hydraulic feeds. The planer is available in four rated sizes, each with a choice of five different stroke lengths from 10 to 20 feet.

Oakite Tri-San, a 20-page booklet published by **OAKITE PRODUCTS, INC.**, 22 Thames St., New York City, describes their chemical material for controlling obnoxious odors by cleaning and disinfecting. *Steam-Detergent Cleaning with Oakite Solution-Lifting Guns*, also published by the same company, is a 28-page booklet on maintenance cleaning of all types of machinery and equipment.

HARDINGE BROTHERS, INC., Elmira, N. Y., has published *Bulletin F*, featuring their precision ground circular form tools for chucking machines, turret lathes, and all automatics, including Brown & Sharpe screw machines. The bulletin includes definite how-to-order instructions, providing for manufacture to customer blueprint of the form tool, or to a blueprint of the part to be produced.

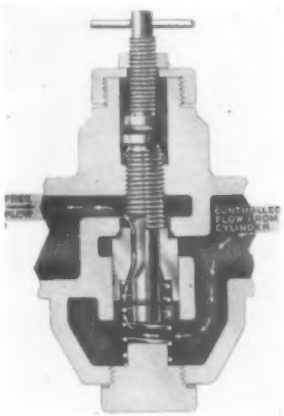
TOOLS OF TODAY

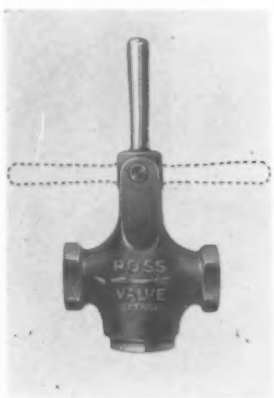
For this issue, our Tools of Today Department will be devoted entirely to air and hydraulic devices. And, while it is not claimed that all items displayed are new (some are), they do represent late developments and current models and the whole constitutes an Exposition wherein the reader may select the appliances suited to his requirements.

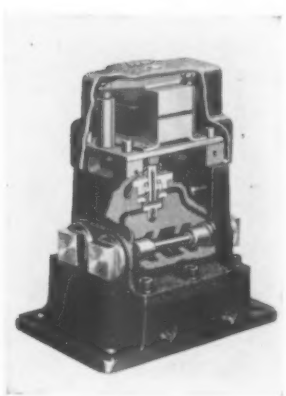
The Editors

New Ross Control Valves

A NEW **SPEED CONTROL VALVE,** by *Ross Operating Valve Co.*, 6492 Epworth Blvd., Detroit 10, provides split-second control of piston speed. Air flow is regulated with precision and volume changes are made progressively smooth. There are but two moving parts — a stem and poppet—with the stem so shaped that it forms a venturi for the passage of air in small volume. Also announced, by Ross, is a **SHUT-OFF VALVE,** at left below, which is primarily designed for use in air lines, but which is also recommended for use in gas and low pressure liquid lines. The features are: Full flow—i.e., full pipe area; quick action flip lever; automatic locking in both closed and open positions; positive shut-off, with line pressure providing leak-proof seal, and visual indicator to show open or closed position.







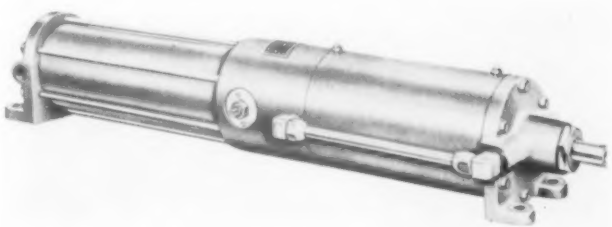
The most recent product, by Ross, is the piston poppet, pilot operated **SOLENOID VALVE,** shown below at right. Small and compact, and rugged in construction, this new valve is claimed to permit operating cycles up to 400 per minute with current consumption 1.2 amps at 110 V. 60 cycles.

This valve is already in production and is available in 3-way (normally open and normally closed) 4-way and 4-way 5 port, and in ¼", ⅜", ½" and ¾" sizes. Bulletins on these valves may be had on request.

New "Rotocast" Cylinders

The Logansport Machine Co., Inc., Logansport, Ind., is making a new line of **HYDRAULIC CYLINDERS** with centrifugal-cast barrels for oil or water at pressures up to 1500 psi.

The cylinders are offered in seven mounting types, three piston-rod models and nine standard bores. An improved method of producing cylinder barrels—centrifugally cast from close-grained grey iron—permits retention of original accuracy of dimensions for the life of the cylinder. Soft synthetic "O" rings are used to provide a permanently leak-proof seal between the cylinder barrel and end covers.



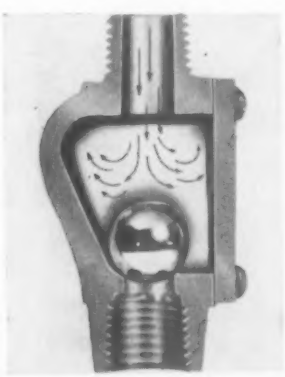
Also, by *Logansport*, a line of **AIR-DRAULIC CYLINDERS,** self contained units that, while essentially air cylinders controlled by any 4-way valve, have the sure, controlled power of hydraulics.

As the rod with its two pistons is moved, oil flows between the chambers of the hydraulic cylinder, which are connected externally in a self-contained circuit. An adjustable, built-in speed control valve, in this circuit, regulates the flow of oil and also the speed of piston movement.

These units are widely applicable to machine tool slides, index devices, feed and traverse of drills and other work heads, and for similar "conversion" to power feeds and movements.

Safety Check Valve

INCORPORATING ONLY TWO PARTS—a housing and a steel ball—the **NU-MATIC SAFETY CHECK,** by *Hackett Mfg. Co.*, Oakland, Cal., eliminates danger of whipping compressed air hose by shutting off the air immediately in the event of excessive air flow caused by accidental breaks in line connections.

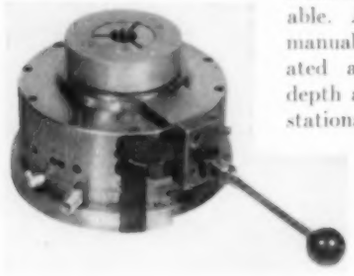


As seen by the photo, the ball rests in a sump at the compressor end of the valve. The sump slopes upward toward the discharge end. Excessive flow of air causes the ball to roll up the slope until it seals off the port, cutting off the air supply. The valve is for working pressures up to 250 lbs., and comes in standard ½" and ¾" sizes.

Collet Air Chucks

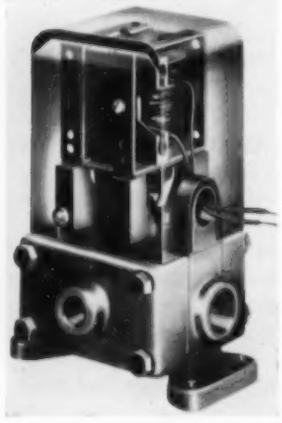
DESIGNED TO PROVIDE ease of operation and to reduce errors in indexing, an air operated **COLLET INDEXING CHUCK** has been added to the line of air operated chucks by *Redmer Air Devices Corp.*, 601 Washington Blvd., Chicago 6. The fixture is so constructed that indexing posts and numbers are on the outside, hence, it is not necessary to remove it from the bed of the machine when changing over to another position.

The chuck has 2-3-4-5-6-8-9-12 positioning indexes as standard, with specials available. And, while indexing is manual, the collet is air operated and, to insure uniform depth and center of work held, stationary. Capacity is up to 2" inclusive. The chuck is equally adaptable to tool room and production uses, either as an indexing or conventional holding fixture.

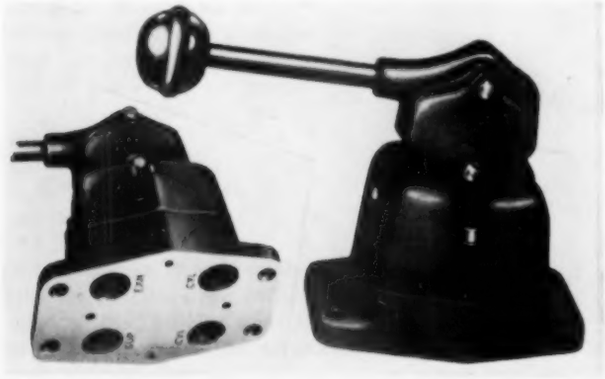


Solenoid Controlled Valve

A NEW **SOLENOID-CONTROLLED 3-WAY VALVE,** for compressed air, by Numatics, Milford, Mich., incorporates the same "Fluid Lever" principle typical of the 4-way solenoid operated valves recently developed by this company. Poppet type, compact and full ported, it provides straight line air flow control with very little mechanical action. The solenoid draws less than 3 amps on 110 v 60 cycle current. Exhaust is one pipe-size larger than supply, for quick dissipation of exhaust; however, flow can be reversed. Mountable in any direction, the valve is available in 6 sizes for ¼" to 1¼", with operating pressures up to 150 lbs.



Also, by Numatics, is a new 4-way **HAND CONTROLLED MODEL** in the H-4 Series. This too, is of the full ported poppet type but, instead of the usual four poppets, it has only two. All ports are on one face with both outlet connections at one end to facilitate piping. There are no stuffing boxes or springs. No sub bases or mounting brackets are necessary, and since all working parts are contained in the upper housing, installation can be permanent. They are available in sizes ¼" to 1¼", locking or non-locking.



Rollway Pumps By Pioneer

ROLLWAY PUMPS, by *Pioneer Pump & Mfg. Co.*, 19645 John R St., Detroit 3, are low speed, positive displacement units primarily designed to handle lubricating liquids. They are available in either reversing or non-reversing pumps and may also be had with built-in relief valve. Capacities range from one pint to 60 gpm, with recommended operating speeds ranging from 200 to 500 rpm.

A variety of drive arrangements is applicable to all Rollway models, which develop and retain a high vacuum and may therefore be set considerably above the surface of the liquid being pumped. As a feature of construction, the roller floats inside the cylindrical housing, without being subject to rotary friction.

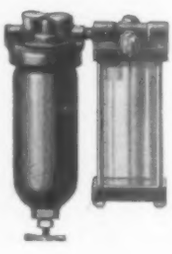
Pioneer Model VBA, at left below, is distinguished by close coupled, compact design which allows it to be used in limited spaces beyond the range of pumps in its class. Also, because of a considerably lower inlet, it is ideal for use where a very shallow sump is necessary or where the pump must be mounted as near the base of the tank or machine as possible.

Model VA, at right, is designed for use in a coolant sump or in a separate tank, and is ideal for use with fluids which may contain large amounts of abrasives. The pump is integral with the heavy duty, long hour, totally enclosed ball bearing motor. A grille, at the bottom, serves as intake and also prevents entry of large pieces of foreign matter.

Two similar models—VBD and VC—are for use where outside mounting is possible. Features are identical with the VA, except that there is no grille and mounting is accomplished either by the base of the pump or by a separate bracket. The VBD functions particularly well in shallow places or where a low coolant line is desirable. Capacities range from 13 to 148 gpm.

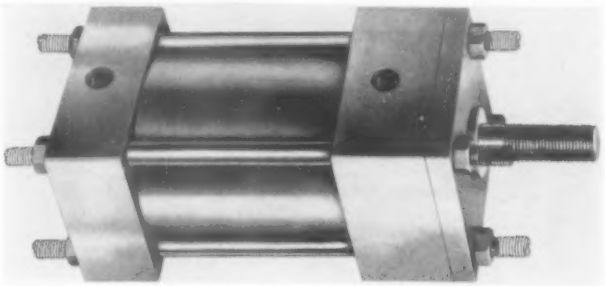
Automatic Lubricator

AVAILABLE in oil capacities ¼ pint to one pint, and in pipe sizes ¼" to 1", an automatic **LINE FILTER and LUBRICATOR,** by *M. B. Products Co.*, 130-134 E. Larned St., Detroit 26, removes all foreign matter, dust, pipe scale and moisture from air lines. Then, by saturating the air with any desired volume of oil, it will lubricate air valves, cylinders, pneumatic tools and controls.



Air and Hydraulic Cylinders

A NEW LINE OF AIR and HYDRAULIC CYLINDERS, with unique mounting features and steel construction, is now offered by *Miller Motor Co.*, 4027-33 N. Kedzie Ave., Chicago 18. The 200 lbs. pressure air cylinders have steel heads and caps and brass cylinder walls. The 1500 lbs. pressure hydraulic cylinders have solid steel heads, caps and walls.



Two special cylinders have also been developed. One is an air-operated hydraulic booster for multiplying power for use in small, light weight, portable units. The other is a dual-stroke welder cylinder that combines an adequate opening to insert and position material with a shorter rapid welding stroke that repeats as many times as desired.

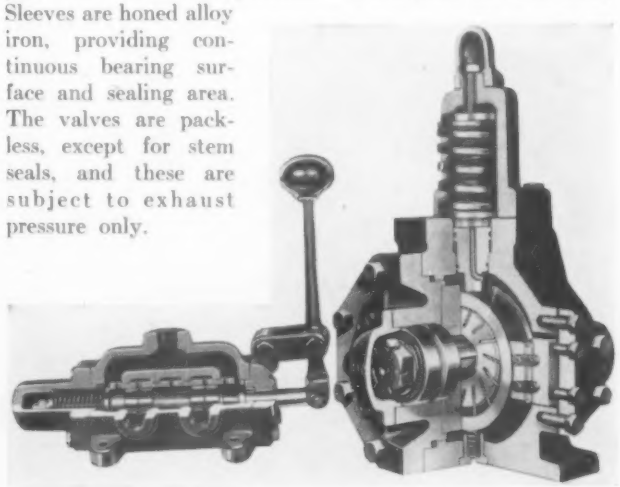
Bulletin A-103, on standard air cylinders, and Bulletin H-104, on hydraulic cylinders, are available on request.

Racine Hydraulic Units

HYDRAULIC EQUIPMENT by *Racine Tool & Machine Co.*, Racine, Wis., is confined to systems using oil as the fluid medium and both pumps and valves are designed for pressure ranges up to 1000 psi. Racine Variable Volume **HYDRAULIC PUMPS** are of the radial vane type, and are made in three standard sizes: numbers 2, 4 and 6, respectively rated at 12, 20 and 20 gpm.

Two pressure pump controls (optional) make possible both high and low pressures with a single pumping unit, and either or both high or low pressure can be set to and maintained at the pressures desired. Also, positive volume controls provides for accurate control of cylinder speeds by varying the volume of oil delivered by the pump. Should higher pressures than 1000 psi be required, a Racine pressure booster may be used. Available in five sizes, these units boost pressures to 3000 psi.

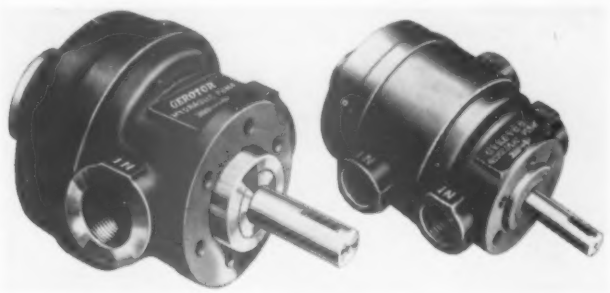
Racine **HYDRAULIC VALVES** are of the balanced piston sleeve type, and may be had for manual, solenoid, pilot and mechanical operation in a complete range of sizes. Sleeves are honed alloy iron, providing continuous bearing surface and sealing area. The valves are packless, except for stem seals, and these are subject to exhaust pressure only.

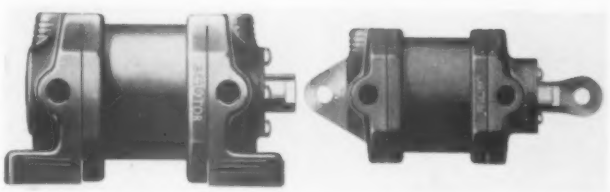


Pumps by Gerotor May

HYDRAULIC PUMPS, by *Gerotor May Corp'n*, Baltimore 3, Md., employ a pair of gear shaped elements, both revolving in the same directions and with the inner member having one tooth less than the other. The result is a low, relative speed, with continuous fluid flow at high pressure.

Type B, at left in illustrations, is a single unit designed for oil service and available in three series with capacities from 4 to 40 GPM and more up to 1000 psi. Series H.H., at right, is a double unit hydraulic pump, available in ten different delivery combinations. Both pumps shown are for plain mounting; however, they are also available in base and flange mountings.



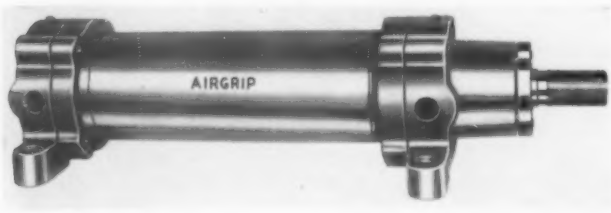


Also, in the Gerotor May line, are air and hydraulic valves and air and hydraulic cylinders. Shown below, at right, is the Model 211 **HYDRAULIC CYLINDER** with foot mounting. Available in all standard mountings, these cylinders are designed for oil or water service up to 1500 psi. At left, below, is the Model 161 **AIR CYLINDER**, in clevis mounting. These cylinders are modernly designed for air pressures to 150 psi and oil and water to 300 psi. Gerotor air cylinders may be had rotating and non-rotating in all standard mountings.

Cylinders by Anker-Holth

IN ADDITION to the standard line of Air Cylinders, as shown, *Anker-Holth Mfg. Co.*, Port Huron, Mich., now offers a complete line of Non-Rotating **HYDRAULIC CYLINDERS** in eleven sizes and seven standard mountings. Features include peeper ring design (absence of tie rods) and cushions, at no extra increase in overall length.

A-H Cylinders are designed for low and high pressures from 750 to 2000 psi and are available in sizes from 1½" to 8" bore in the following mountings: Fort; Trunnion; Center line; Clevis; Flange (rod end and blind end) and Adapter. The line also includes double ball bearing, double acting Rotating Hydraulic Cylinders.



New Speed Control Valves

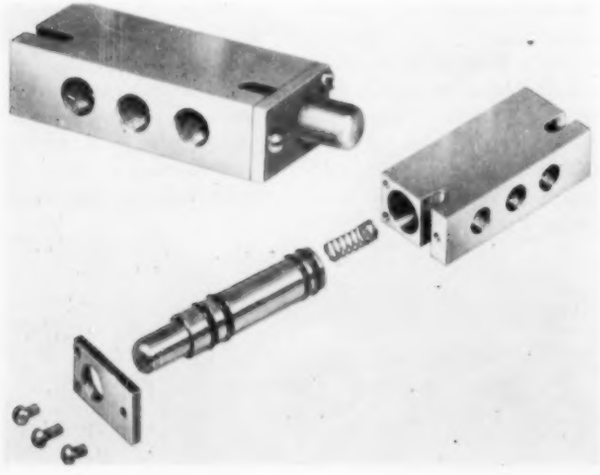
A NEW LINE of **SPEED CONTROL VALVES,** to provide increased control efficiency, is a new development by *Hanna Engineering Works,* 1765 Elston Ave., Chicago 22. One type, for tubing and light piping applications, and designed for 4-way operation, is suitable for air, oil, or water in pressures up to 250 psi.

A foot-operated variety comes in two styles, with single pedal for constant cycles of operation and with split pedal that holds position until tripped for reversal. This model operates on 250 psi air pressure or 1000 psi oil pressure. Still a third type offers two-directional control and provides for adjustable control of inflow and outflow of air or oil independently to and from one side of the piston. Working pressures are 250 psi, for air cylinders, and 1000 psi for hydraulics.

Three-Way Pilot Valve

A NEW MODERNAIR 3-way pilot valve, designed for use in the application of controlled air power to machine tool applications has been announced by *Modern Products, Ltd.,* 952 So. Grand Ave., Los Angeles 15, California. The valve is compact, being 3¼" overall with the piston fully extended. CRV valves are operated by hand, foot treadle or cam which may be part of a timed sequence of operations.

The valve is used to operate air cylinders, air motors, air controls and single-acting cylinders, such as those used on pneumatic vises, chucks and fixtures. The valve may also be used in low pressure control and actuating systems.

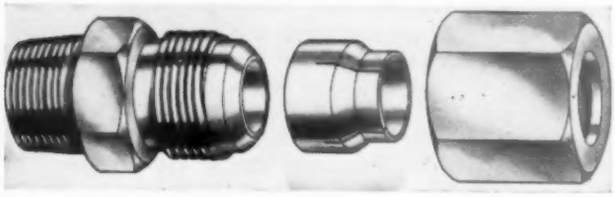


Speedy Vapor Cleaning Unit

A MULTIPLE-DUTY steam cleaning outfit, known as the **OAKITE-VAPOR CLEANING UNIT,** developed by the *Oakite Products, Inc.,* 57 Thames St., New York 6, is a self contained, down-draft flame, oil-fired, enclosed coil-type steam generator that delivers hot vaporized cleaning solutions, under selective pressures up to 200 lbs., for the speedier, easier removal of grease, grit, grime, paint and other deposits from surfaces. Descriptive folder is available.

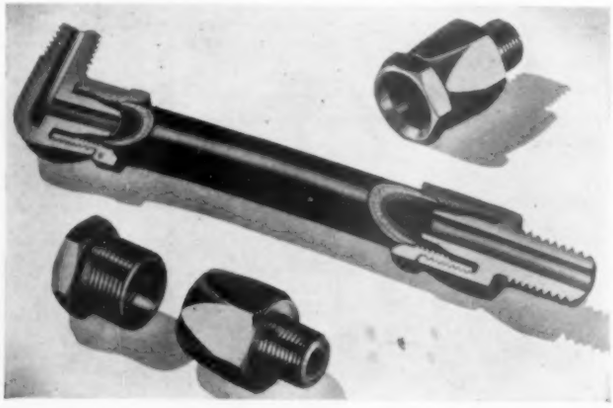
Grip Tube Fittings

DESIGNED for pressure installations where fluid must be sealed, **GRIPTUBE FITTINGS,** by *Flodar Corp'n,* 331 Frankfort Ave., Cleveland 11, employ a unique yet simple principle to effect sealing and grip. The fitting consists of three parts—a connector body, a tightening nut and a contractible sleeve. The latter has a solid forward end and a slotted rearward end tantamount to spring fingers which close and grip the tube as the nut is tightened.



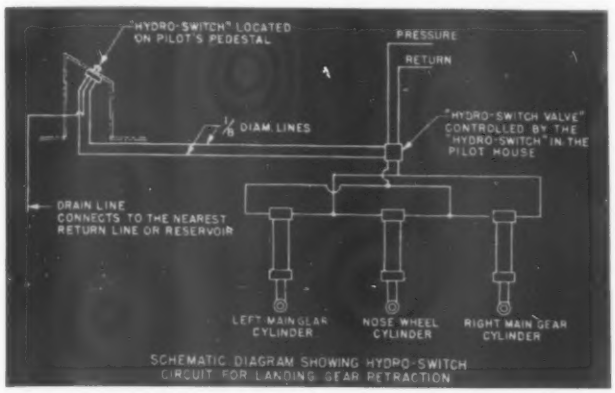
Reusable Hose Couplings

A COMPLETE LINE of attachable-detachable reusable **METAL COUPLINGS,** by *Resistoflex Corp.,* Belleville, N. J., now makes it possible to hand assemble flexible hose lines. The coupling nut threads into the hose, with the shell compressing the hose end into a safety seal gasket. The fitting has a long, even grip on the hose, while the bell shaped nut allows flexing without cutting.



The "Hydro-Switch" System

DESIGNED to provide a reversal of hydraulic flow, the **"HYDRO-SWITCH"** by *Air Associates, Inc.*, Teterboro, N. J., is unique in that it operates by flow rather than by hydraulic pressure. Also, only two lines are needed for 4-way operation. A third line, which may be connected to the nearest return line, merely serves as a drain.


"HYDRO-SWITCH" LOCATED ON PILOT'S PEDESTAL
PRESSURE
RETURN
⅛ DIAM. LINES
"HYDRO-SWITCH VALVE" CONTROLLED BY THE "HYDRO-SWITCH" IN THE PILOT HOUSE
DRAIN LINE CONNECTS TO THE NEAREST RETURN LINE OR RESERVOIR
LEFT MAIN GEAR CYLINDER
NOSE WHEEL CYLINDER
RIGHT MAIN GEAR CYLINDER
SCHEMATIC DIAGRAM SHOWING HYDRO-SWITCH CIRCUIT FOR LANDING GEAR RETRACTION

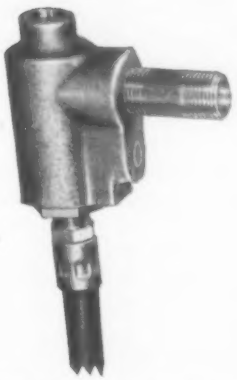
Operation is simple. A turn of the knob, on the switch, (which is connected to the valve by ⅛" lines) actuates the valve, which then functions after the manner of any conventional 4-way valve.

The circuit employs only one switch and one valve, and both weigh but a little over one pound as against many times that weight for conventional units. And, as seen by the diagram, control from switch to valve may be remote, with only small, flexible tubing required for connection between the two.

Barnes Power Units

TWO SELF-CONTAINED **POWER UNITS**, by *John S. Barnes Corp'n*, Rockford, Ill., combine flexibility with smooth fluid power. One, the F10-A Power Unit (shown), employs a gear pump and is of 9 gallon capacity with maximum pump delivery 5 gpm with maximum pressure 500 psi. The larger unit—F-20-A—employs the Barnes Roto-blade pump and has a capacity of 27 gallons with maximum delivery 12½ gpm and maximum pressure 1000 psi. Bulletins 303-U and 304-U give complete specifications.

Automatic Speed-Up Valve

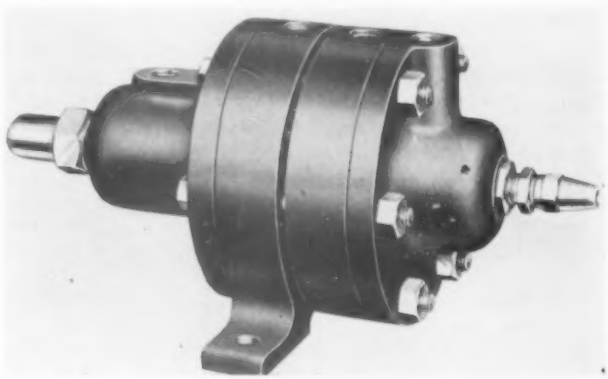


DESIGNED for use in combination with operating valves, an **AUTOMATIC AIR VALVE**, by *Bryant Products Co.*, Jackson, Mich., speeds up air cylinders from 50 to 200 percent.

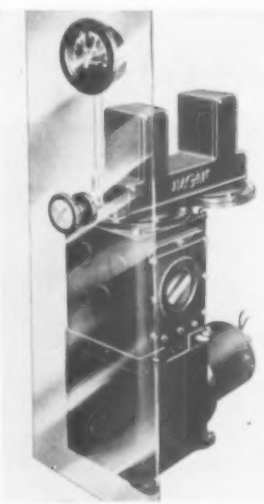
The automatic valve lets air into the cylinder, then, when the operating valve is opened, it automatically opens a part of the cylinder for exhaust. For a spring returned cylinder, a 3-way operating valve and one automatic valve is used; if cylinder is double acting, a 4-way operating valve and two automatic valves are used.

New Pneumatic Relay

A NEW PILOT OPERATED, pneumatic relay—called the **TYPE F TOTALIZER**—is available from *Hagan Corp'n*, Hagan Bldg., Pittsburgh. Used to add or subtract loading pressures from external sources, the device may also be used as a regulator in connection with a measuring fluid element and a power unit to regulate fluid flow, temperature, pressure, level, speed or any other physical condition that can be transformed into a loading pressure as an indication of magnitude.



When used as an element in a control system it will add or subtract loading pressures; average two or more loading pressures; act as a selector for loading; respond to sequential loading pressures; operate as a safety relay or act as a pneumatic stop for diaphragm operated valves and regulators. Descriptive literature available.

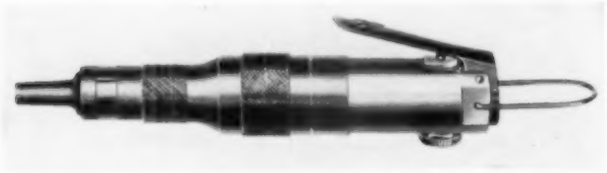


Also, by Hagan, the Type 2-SO Regulator. Diaphragm actuated pilot type, oil powered, this device is used in connection with a power cylinder and a source of oil under pressure to regulate valves and dampers for maintaining a constant relation between two pressures or differentials at some desired point in a flow system. Range is as —0.10" water column and 5 psi differential; static pressure and 35 psi. Bulletin available.

Air Tools by Ingersoll-Rand

INCLUDED IN A WIDE RANGE of air equipment and tools by *Ingersoll-Rand Company*, 11 Broadway, New York 4, are screw drivers and impact wrenches which have wide use in industry. Shown at upper right, below, is the **NON-REVERSIBLE SCREW DRIVER**—Size 00A—furnished with pistol grip handle and trigger type throttle. Speeds range from 1100 to 4500 rpm, and under average conditions these tools will drive free running screws up to ¼", or self tapping up to No. 10. A cushion clutch minimizes rotary impact and allows delicate torque adjustment. Also the motor may run but rotates the bit only when the operator exerts a slightly pressure on the screw driver.

Reversible **IMPACT WRENCHES**, as at lower left, are adapted to screw driving, and are furnished with a quick change anvil which accommodates screw driver bits with ¼" hex shanks. "Rotary" impact action permits larger screws to be driven than would be possible with a torque type of the same motor size. Size 502 has a conventional pistol grip handle with trigger type throttle (similar to the 00A) while the size 502B features a straight handle with lever throttle and suspension ring. Both are of same capacity.



Also, among I-R air tools, are the Reversible and Non-Reversible **SCREW DRIVERS** with straight handles and lever type throttles, but otherwise identical in performance and general construction to the size 00A described above. These tools which handle screws up to No. 8, measure but 7-3/16" overall with standard bit and fender and weigh only 19 ounces. Size 500B shown below.

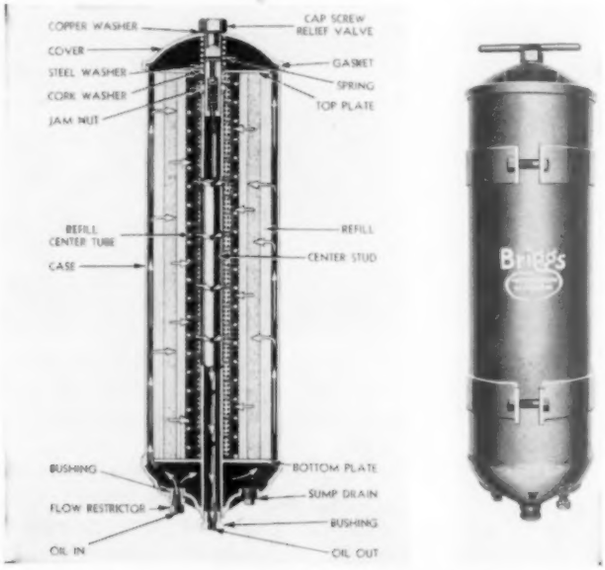
New Selector Valves

2, 3 AND 4 WAY **SELECTOR VALVES**, by *Hydro-Aire, Inc.*, 626 North Robertson Blv'd, Los Angeles, are designed for flows up to 2500 gallons per hour with negligible pressure drop. Incorporating patented pressure seals, the units can be used for any type of liquid, at temperatures ranging from minus 65° F. to plus 200° F.

Of extremely light weight and low operating torque, they may be positioned at 200 psi and will withstand operating pressures to 1000 psi. Sizes range from ⅜" to 1½" pipe thread.

Hydraulic Oil Filters

OIL FILTERS, used extensively to remove sludge and impurities from engine oil, are now available for industrial uses from the *Briggs Filtration Company*, Bethesda 14, Md. The unit consists of a tank—or outer casing—in combination with a renewable filtering cartridge, as shown in the sectional view. They are made for various requirements, as for filtration by absorption and by straining, and are applicable to manifold hydraulically operated appliances.

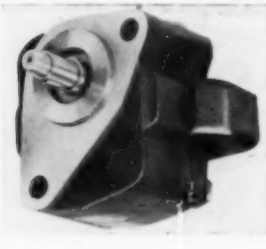


Automatic Flow Regulator

A NEW **AUTOMATIC FLOW REGULATOR**, a product of the *Waterman Engineering Co.*, 721 Custer Ave., Evanston, Ill., is claimed to assure perfect hydraulic control in a space but a fraction larger than the line in which it is used. It is available in all pipe sizes and provides unlimited flow in one direction and predetermined flow in the opposite direction. It is fully described in a circular, available from the manufacturer.

New Aro Gear Type Pump

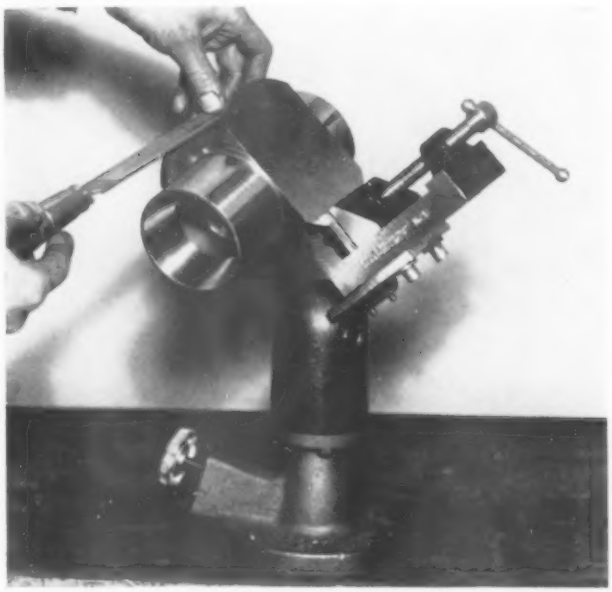
Aro Equipment Company, Bryan, Ohio, announces a new gear-type **HYDRAULIC PUMP** H657-A—of 5½ G.P.M. capacity at 2000 psi. Volumetric efficiency, using S.A.E. No. 10 oil is said to be 90% with overall efficiency about 500 psi 85% or better. It is suitable for hydraulic systems ranging from 100 to 2000 psi., and is said to surpass standard durability and performance with "plenty to spare."



The body is "sandwich" design, with the assembly an approximate 3½" cube except for shaft extension port bosses and threaded portion for ¼" nut. The mounting flange is adaptable to users requirements.

Versatile Positioner

Of MORE than usual interest, in hydraulic devices, is the **POWRARM** by the *Garfield Engineering Corp'n.*, Kansas City 6, Mo. This tool is a combined work holder and positioner with practically unlimited applications. Various holding devices can be substituted for the vise shown, and work may be positioned for utmost convenience. A mere turn of the screw, shown at bottom, applies hydraulic pressure and positively locks the vise in any desired position. The tool may be bench or stand mounted, as desired.



Automatic Coolant Separators

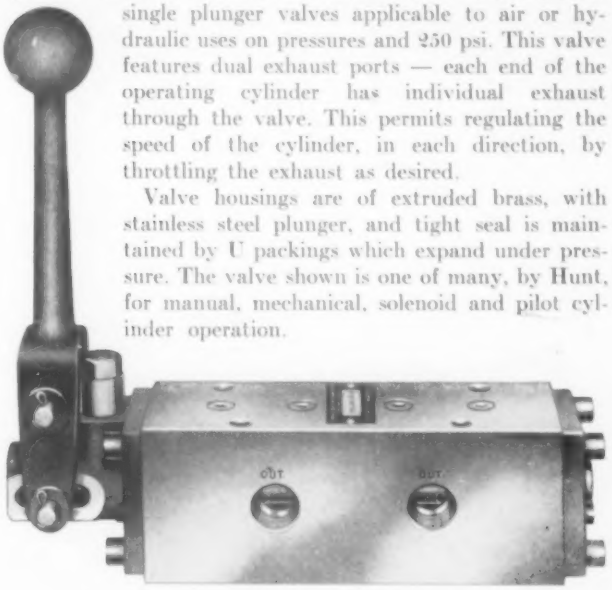
A MAGNETIC **COOLANT SEPARATOR**, by *Barnes Drill Co.*, 814-830 Chestnut St., Rockford, Ill., is just what the name implies and is designed to separate ferrous particles in coolants used for grinding and honing. It thereby improves quality of surface finish by preventing scratches that might otherwise be caused by these particles.

The unit is self contained, of large capacity, fully automatic and easily installed. The drum is constructed with a series of permanent magnets, and faced with a non-magnetic sheet through which the magnets attract and hold all magnetized swarf. The latter is continuously scraped off as the drum rotates, and discharged into a receptacle. The operator is only required to start and stop the Separator motor.

4-Way Single Plunger Valve

A 4-WAY lever operated **NEUTRAL POSITION VALVE**, by *C. B. Hunt & Son, Inc.*, Salem, Ohio, is one of a line of single plunger valves applicable to air or hydraulic uses on pressures and 250 psi. This valve features dual exhaust ports — each end of the operating cylinder has individual exhaust through the valve. This permits regulating the speed of the cylinder, in each direction, by throttling the exhaust as desired.

Valve housings are of extruded brass, with stainless steel plunger, and tight seal is maintained by U packings which expand under pressure. The valve shown is one of many, by Hunt, for manual, mechanical, solenoid and pilot cylinder operation.

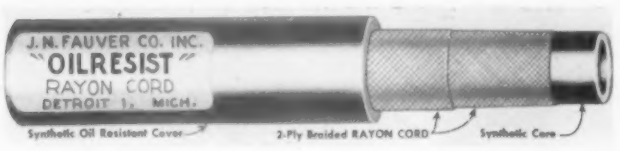


All Purpose Gear Pump

A NEW, all-bronze **GEAR PUMP**, by *Gray-Mills Corp'n*, 1948 Ridge Ave., Evanston, Ill., is especially designed for pumping water, oils, solvents, salt solution, chemicals and other corrosive or non-corrosive liquids. Termed the "GB" Series, the pumps have bronze housing and gears, stainless steel shaft, Oilite bearings and built-in pressure relief valve. Maximum pressure is 300 psi at 1750 RPM. Volume is 6 GPM with ½" discharge outlet. These pumps can be operated by pulley or direct drive and can be mounted internally or externally in a variety of positions. They are available as pump only, a pump and motor or as a complete portable unit with tank.

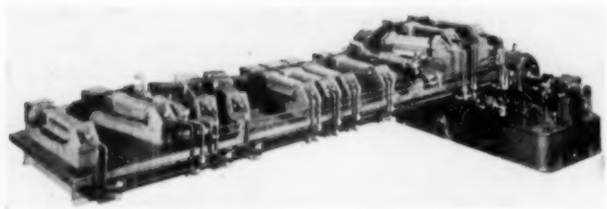
Improved Industrial Hose

J. N. Fauver Co., Detroit, is marketing a new Rayon Cord Synthetic Hose, called **"OILRESIST."** Claimed to withstand 25% greater bursting pressures, and proportionately higher working pressures, the new hose weighs less, has a smaller O.D. for the same I.D., greater flexibility and no stretch or elongation under pressure.



Rivet-Pierce Tools

HYDRAULIC **PIERCING AND RIVETING TOOLS**, by *Mueller Engineering Co.*, 1116 Book Bldg., Detroit 26, augur wide applications in industry. Of unusual interest is the Hydraulic Piercing and Stripping Unit, shown in operation sequences below. The stripper is entirely hydraulic and devoid of springs. During the power stroke, pressure on the stripping cylinder is zero, with full hydraulic force applied to the power cylinder. As soon as the piercing is completed, however, and simultaneous with the retraction of the power ram, the stripper comes into action and, in turn, recedes as soon as the punch is clear of the workpiece.



Action is powerful and smooth, and capacities of the units range from 20 tons at 5000 psi to 100 tons at 10,000 psi. In tests, 9/16" thick steel has been pierced with 21/64" punches, and 3/8" holes have been punched in spring steel, such as bumpers. The units may be applied singly, or ganged for piercing and riveting of complete assemblies. From right to left, in the illustration, is shown the unit, the cylinder with punch head mounted, sectional view of cylinder at completion of power stroke and stripping action completed. The lower photo shows a gang of 11 units in a piercing fixture for automobile side frames.

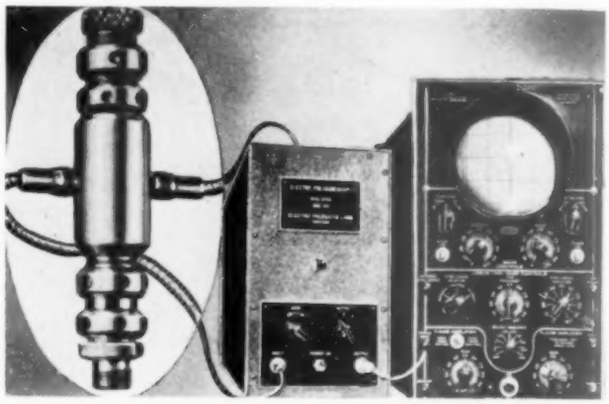
Automatic Water Unloader

THE *Gray Company, Inc.*, Minneapolis 13, announces a completely automatic **WATER UNLOADER** for air compressors up to 10 HP with pressure range from 75 psi upward. Named the Graco Vapor-Scaper, it is especially effective in removing moisture from air lines supplying pneumatic tools and equipment.

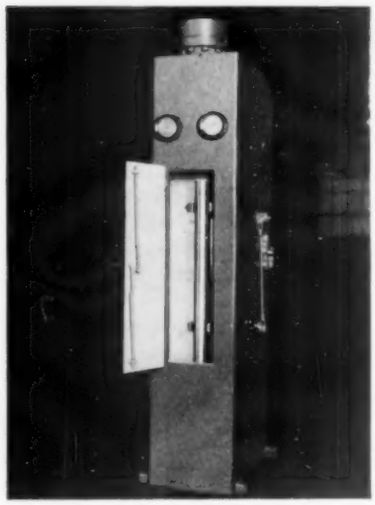
The device is easily installed without special tools, and operation is simple and effective. Whenever the compressor stops, the pressure in the storage tank forces moisture in the bottom out through ports in the water unloader. In this way, the Vapor-Scaper automatically bleeds moisture from the tank, assuring clean, dry air at all times.

New Pressuregraph

IN COMBINATION with a Cathode Ray Oscillograph, a **PRESSURE TIME-CURVE INDICATOR**, by *Electro Products Laboratories*, 549 W. Randolph St., Chicago 6, indicates pressure variations in engines, pumps, compressors, air and liquid pipe lines. The device has three output selections: (1) double modulated wave; (2) indicator card wave, and (3) integrated single line for transmission of pick-up response to oscillograph for photographic recording. All mechanical speeds to 100,000 rpm and pressures to 10,000 psi may be accurately indicated.



New Tube Testing Press



A NEW **HYDRAULIC TUBE TESTING PRESS**, by *Beatty Machine & Mfg. Co.*, Hammond, Ind., is designed for testing tubes up to 3¼" I.D. and 48" long at 4800 psi hydrostatic internal pressure. Within limitations of pressure and space capacities, and with proper ram attachments, the press can be applied to other tests. The press is of 25-ton capacity, with pressing speed 34 ins. per minute and rapid traverse return stroke 68". Stroke is 8", with depth of throat 6". Daylight opening is 57—or 9 inches more than length of tubes to be tested.

Three New Cutting Oil Bases

Sulphur and chlorine have been combined in non-corrosive form by Nat'l Oil Products Co., Harrison, N. J., to produce a unique, extreme pressure cutting oil base known as Nopco 1009-C. Recommended for steel, brass and copper cutting operations, the product is odorless, free from tarry matter, and blends in all proportions with any diluent petroleum oil. Two other new cutting oil bases have also been developed by the company. These are Nopco 1009-A, containing 15 per cent sulphur for use in straight ferrous metal cutting; and Nopco 2009-A, a soluble cutting oil base for rapid removal of frictional heat, and useful for grinding, broaching, and polishing where strong detergent properties are required. The three products are now available to the metalworking trades.

Pneumatic Pressure Vise

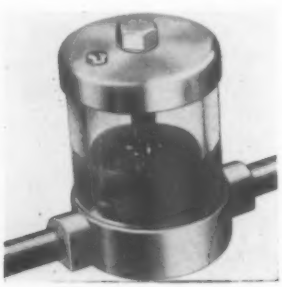
THE *Bryant Products Co.*, Jackson, Mich., announces an improved **PNEUMATIC PRESSURE VISE**, operated by foot valve, for industrial use. While the moveable jaw may be adjusted by hand crank, actual clamping (1" power stroke) is by pneumatic pressure which can be regulated to suit. Ratio is 40:1; and 100 lbs. air pressure converts to 4000 lbs. jaw pressure. The tool is not recommended for air pressures over 150 psi. Jaws are interchangeable, and the tool may be bench mounted as shown or with the moveable jaw up in the form of a small press.

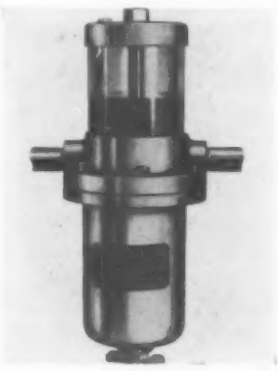
New Filtering Unit

CCA FILTER-LUBE, a compact filtering unit combined with a precision lubricator, by *CCA Products Engineering*, P.O. Box 671, Glendale, Calif., is designed for close installation to the equipment it is intended to service—as, for example, cylinders, vises, chucks or any reciprocating or rotary air tools.

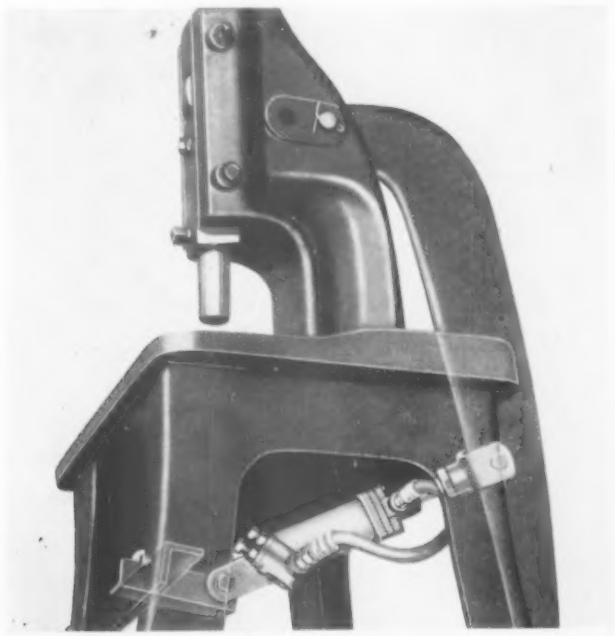
The filter-lubricator is available in ¼", ⅜" and ½" standard pipe sizes. Simple to install on air supply lines, the device enables the operator to see, at a glance, the quantity of oil in the element, and no excess of oil is permitted to enter the working parts of the equipment, or to let them dry.

A new LUBRICATOR, by the same manufacturer, is designed for automatic lubrication of pneumatic equipment, known as the CCA LUBE, is available in ¼" and ⅜" standard pipe line sizes. The following features are claimed by the maker: the device is easily adjustable, fully automatic, compact, simple, and has long life.



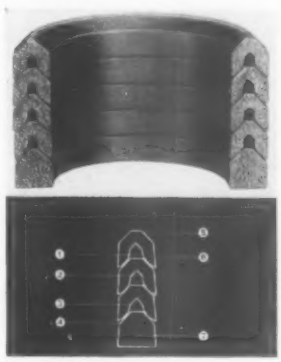


A **PNEUMATIC OPERATING UNIT** which, when installed on any kick press, converts it to power operation, is now in production by the *National Pneumatic Co.*, 420 Lexington Ave., New York 17. Claimed to increase production and thereby cancel out original cost, the air engine delivers 270 lbs rated hp at 100 lbs pressure and is mounted on a pivot type bracket and attached to the kick press lever. If desired, two hand-operated control valves may be substituted for the foot control valve, as an additional safety factor.



Compensating Pressure Rings

DEVELOPED BY *Green, Tweed & Co.*, Bronx Blvd. at 238th St., New York 66, a new design of V type packing—Palmetto **PYRAMID PACKING**—overcomes the tendency to weaken and split at the "hinge." In service, the bottom ring (7) is installed first and receives full pressure impact. This ring expands the wedge spoked lip of each ring above, pressing the packing together against both the cylinder rod and side walls, effectively preventing leakage.



Binding is prevented by infiltration of fluid between the rings (4) and storage in the arrowhead reservoir (2). The curved design of the inner lip (1) also prevents friction within the packings.

New Pipe Joint Compound

A TESTED pipe joint compound, called **PIPETITE-STIK**, has been announced by the *Lake Chemical Co.*, 607 N. Western Ave., Chicago 12, Ill. It is made in handy, stick form. According to a 24-hour test conducted by an independent laboratory, the compound successfully resisted all leakage of gasoline, oil, butane and freon-12.

North East West South in Industry

Henry L. LeMay has been named Manager of the Chicago office of **BAY STATE ABRASIVE PRODUCTS CO.**, of Westboro, Mass. Mr. LeMay, formerly associated with Dusenberg Motors, Indianapolis, Mercedes Benz and Lincoln Motors in California, has for the past several years been active in the abrasive sales field in Chicago for the Norton Co.

Marvin W. Davis, formerly with Hanson & Co., and **Chas. E. French**, formerly with Faigle Tool Co., have organized **DAVIS & FRENCH, INC.**, to serve as manufacturers representatives. Offices will be at 7376 Grand River, Detroit 4. Accounts will include Progressive Industries Co., of Detroit, manufacturers of gages, fixtures, dies and cutting tools, and Machinery Div'n (formerly Foster Machine Co.) and Commercial Welding Div'n, of International Detrola Corp'n. Connected with the new firm will be **Louis Lowy**, formerly district Sales Mgr. for National Tool Co. of Cleveland.

D. S. Harder, President, **E. W. BLISS CO.**, has announced a $2,000,000 expansion program and shift of executive offices from Brooklyn to 450 Amsterdam St., Detroit. The company will continue its manufacturing operations in the Bush Terminal, Brooklyn, as well as maintaining its plants in Ohio, Michigan, England and France.

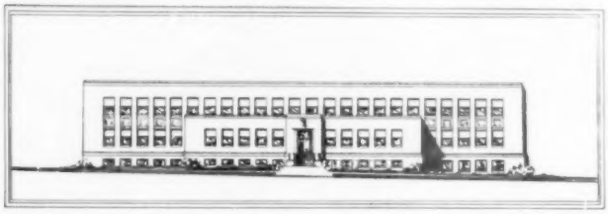
George W. Frick (left) has been made Executive Vice-Pres. of **CARBIDE DIE & MOLD CO.**, according to **Jess W. Spiker**, President. Mr. Frick will also direct sales of the company's line of sintered carbide dies and molds, wear parts, and special tools for the powdered metals, ceramics and pharmaceutical manufacturing fields.

L. R. Rothenberger, associated with the **DoALL CO.**, Minneapolis, Minn., and Des Plaines, Ill., for several years, has recently been appointed General Sales Manager. Mr. Rothenberger will direct sales programs for the company's 38 exclusive sales stores in the U. S., Canada and Mexico, employing 109 sales representatives.

R. J. Swing is the new General Sales Manager of **THE BUNELL MACHINE AND TOOL CO.**, Cleveland. Mr. Swing is well known as both a ferrous and nonferrous metal authority, and, during his 26 years of association with metal manufacturing and sales, has acquired considerable experience in the special tool, die and machine field.

Harvey B. Wallace (right), president of Wheel Trueing Tool Co., Detroit, and of Adamant Tool Co., Bloomfield, N. J., has been elected president of the newly formed *Industrial Diamond Ass'n of America*. Other officers elected include **I. J. Meade**, 1st Vice-Pres., and **Chas. J. Koebel**, president of Koebel Diamond Tool Co., Detroit, elected as Vice-President. Directors include Irving R. Berk, Louis Chambre, Stephen W. Hofman, Frank Koebel, Harold DeS. Mendes, James A. Ross, H. R. Spandel and Chas. Ullman. Athod D. Leverage, formerly chief of the Diamond Dies Section, W.P.B., was named executive director and sec'y-treasurer.

Anticipating the commercial building "freeze," **CARPENTER STEEL CO.**, Reading, Pa., had broken ground for a new research laboratory. First floor plans include installation of experimental melting and rolling equipment, heat treating department, machine shop and physical testing laboratory. The second and third floors will accommodate metallurgical and chemical laboratories respectively.



M. E. Burkhart has joined the **K. P. WESSELING CO.**, St. Louis, Mo., manufacturers' agents, as Vice-President in charge of a new Engineering Department to provide machine tool customers with professional engineering consultant service. Mr. Burkhart was formerly vice-president of the Key Co., East St. Louis, Ill.

Bernie G. Silberstein, former manager of **ILG ELECTRIC VENTILATING CO.** branch office in Cincinnati, has been appointed Ohio Valley District Manager for the company. After a year and a half with the Westinghouse Electric Supply Co., he became associated with Ilg, and in 1929 was promoted to his previous post as branch manager.

W. J. Hawley (right) will head the Machine Tool Sales Dept., **KENT-OWENS MACHINE CO.**, Toledo, Ohio, manufacturers of milling machines and special industrial machinery. According to announcement by **E. W. Donkel**, General Manager of the company, Hawley will be associated with **W. J. Donkel, Jr.**, Vice-President, in directing sales policies.

How do you tell Age?

Heald engineers can show where outdated machines are costing you money

The age of a machine tool is measured by its capacity to produce—to actually *earn* money—not by years of service. That's why, with today's rising production costs, so many wartime machines are old beyond their years . . . outmoded by new ideas, new methods, new demands.

Regardless of design or condition, the *minute* your machine can be replaced by one that does the same job better—with greater output, to closer tolerances—you've got an obsolescent machine on your hands. And obsolescence means higher production costs.

Heald's staff of 200 engineers will show you how obsolescent equipment can be *profitably* replaced in every instance . . . by using the most efficient machining methods, either precision grinding or borizing, suited to your *particular* job. Whether you use one machine or a hundred, Heald engineers can help you to gain a better competitive position by improving your production and cutting your costs. For further information, write: THE HEALD MACHINE COMPANY, Worcester 6, Mass.

HEALD

means more precision
. . . less cost

WITH A HORSE . . .
you count teeth

WITH A TREE . . .
you count rings

BUT WITH A MACHINE . . .

INTERNAL AND SURFACE GRINDING MACHINES • BORE-MATIC PRECISION FINISHING MACHINES

WITH STEEL GAGES-GAGE LIFE WAS 24 HOURS *Yesterday*

Today—

GAGE LIFE IS *8 months* WITH
NORBIDE GAGES

This NORBIDE Plug Gage gave eight months' service where previously one steel gage was worn out every day. The gage was used on a grinding job on an internal grinder where the work was checked on the machine. The NORBIDE gage replaced at least 160 steel gages and, therefore, enabled the plant to save about $1200 over the eight months' period.

Because Norton Boron Carbide is the hardest material made for commercial use, NORBIDE gages outwear conventional types of measuring devices 150 times and more. In addition to their great wear resistance NORBIDE gages will not pick up lint nor become charged with particles of metal and they are inert to chemicals employed where gages are used.

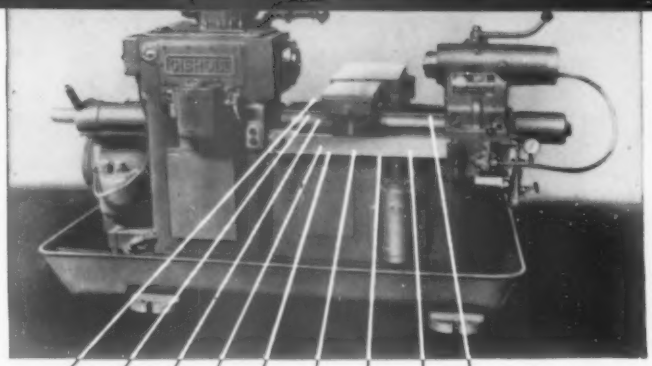
Ask your regular supplier about NORBIDE gages or for additional information write to:

NORTON COMPANY • Worcester 6, Mass.

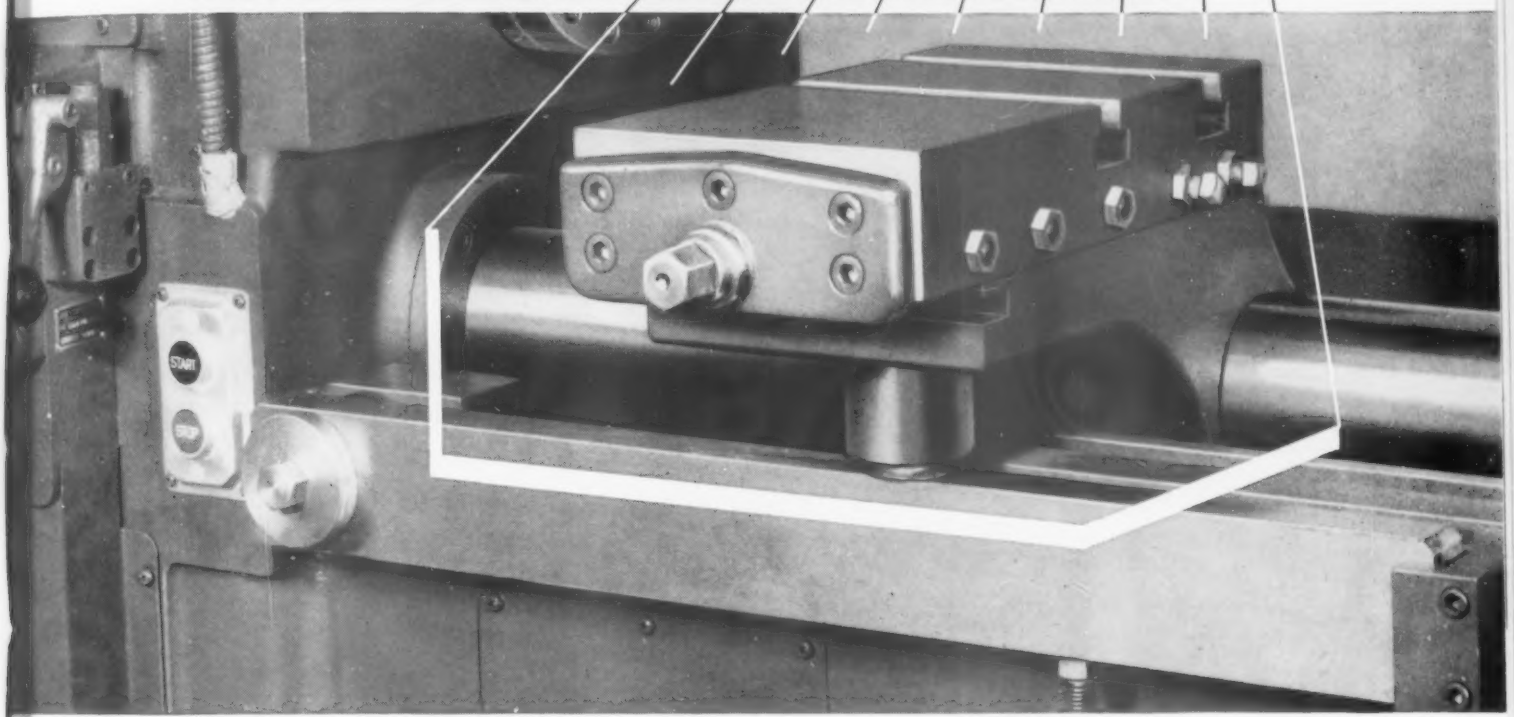
NORBIDE - The Hardest Material Made by Man
REGISTERED TRADE-MARK

Why this front carriage is more versatile

Here's one of the many reasons why this machine can perform a number of different machining cycles and handle a remarkably wide range of work for an automatic lathe.



THE GISHOLT HYDRAULIC AUTOMATIC LATHE



The front carriage is clamped to, and receives its longitudinal motion from, a large diameter hardened steel bar along which the carriage may be clamped at any position.

The outer support for the carriage is a hardened steel beam of rectangular section, pivoted at one end and with an up-and-down motion for the other end provided by the piston-cylinder unit on the front of the machine. Raising or lowering this beam imparts a transverse movement to the carriage.

Many combinations of transverse and longitudinal motions can be made at both feed and traverse rates to meet practically every requirement. An angular in-feed attachment may be added for advancing multiple tools into the work at a controlled angle.

With a rear slide which can be placed on the bed table to feed in or out, straight or angularly, you have the combination that means faster, lower cost production on a wide variety of parts. Write for literature.

GISHOLT MACHINE COMPANY

1257 E. Washington Avenue • Madison 3, Wisconsin

Look Ahead... Keep Ahead with Gisholt

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

Engineers · Designers · Builders

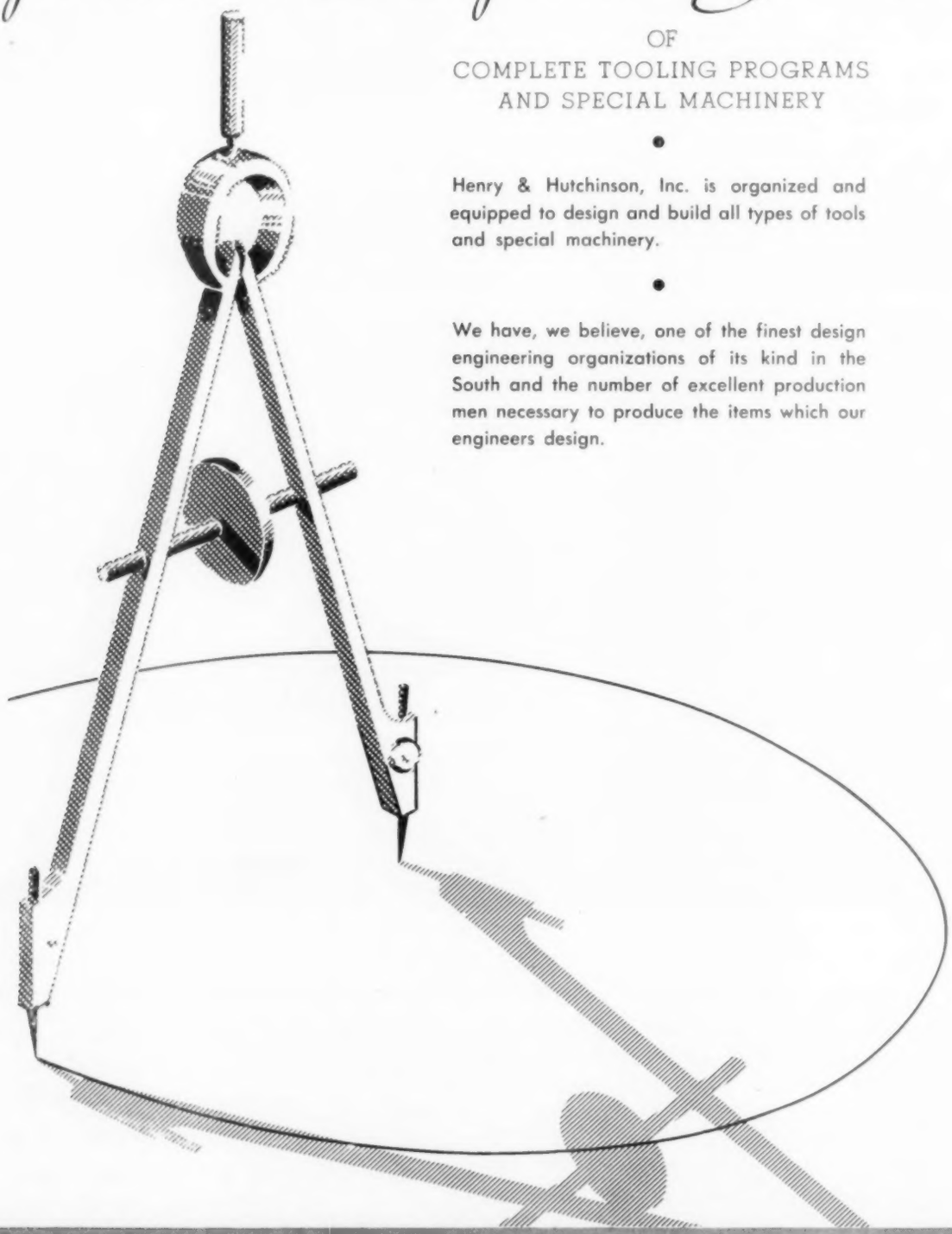
OF
COMPLETE TOOLING PROGRAMS
AND SPECIAL MACHINERY

•

Henry & Hutchinson, Inc. is organized and equipped to design and build all types of tools and special machinery.

•

We have, we believe, one of the finest design engineering organizations of its kind in the South and the number of excellent production men necessary to produce the items which our engineers design.



HENRY & HUTCHINSON, INC.

DECATUR (ATLANTA), GEORGIA

PRODUCTION ILLUSTRATORS **TOOL PLANNERS** **PRODUCTION ENGINEERS**

CLE-FORGE HIGH SPEED DRILLS

TRADE MARK REG U.S PAT OFF

. . your assurance of HIGH QUALITY PERFORMANCE *at* LOW COST

Experienced machinists choose the tool that does the job *quicker* and *better.* Experience has taught them that CLE-FORGE High Speed Drills are not only the most satisfactory on every count, but actually cost less per hole. You cannot buy better drills . . . and no drills will give you lower costs.

This illustrated booklet answers hundreds of questions about Twist Drills . . . grinding, correct feeds and speeds, how to correct common errors in drilling, etc. Write to Dept. L for your free copy.

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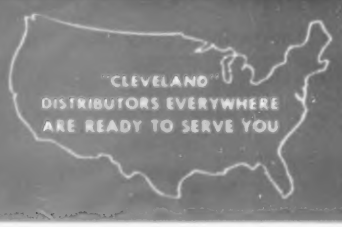


TO HANDLE COMPLEX TOOL GRINDING JOBS

with maximum speed and convenience

use G&L's GRAND RAPIDS No.4

Universal Cutter and Tool Grinder

EXTREME FLEXIBILITY of the No. 4 Universal Cutter and Tool Grinder permits two ways of performing nearly every operation: 1. With the spindle head locked, the sleeve and knee swivel around the column; 2. With the sleeve locked the head swivels on the column.

VERSATILITY of the No. 4 Universal Cutter and Tool Grinder makes all of the following grinding jobs practical and simple:

GEAR CUTTER GRINDING

ANGLE CUTTER GRINDING

INTERNAL GRINDING

CYLINDRICAL GRINDING

FACE GRINDING

FACE MILL GRINDING

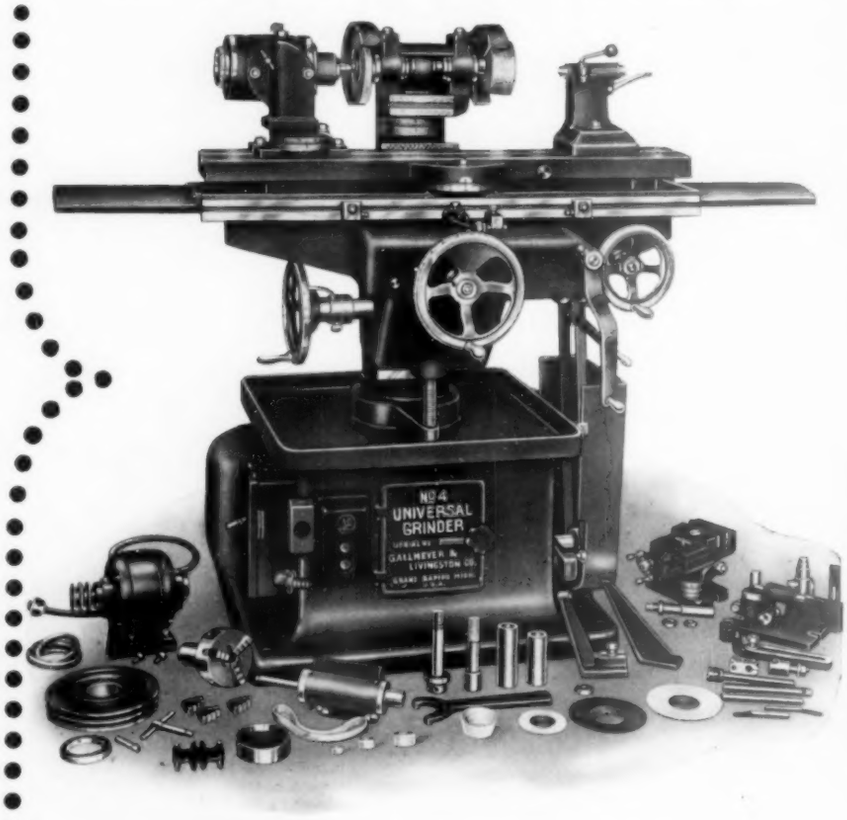
END MILL GRINDING

FORMED CUTTER GRINDING

SURFACE GRINDING

HOB GRINDING

Write for Bulletin 544



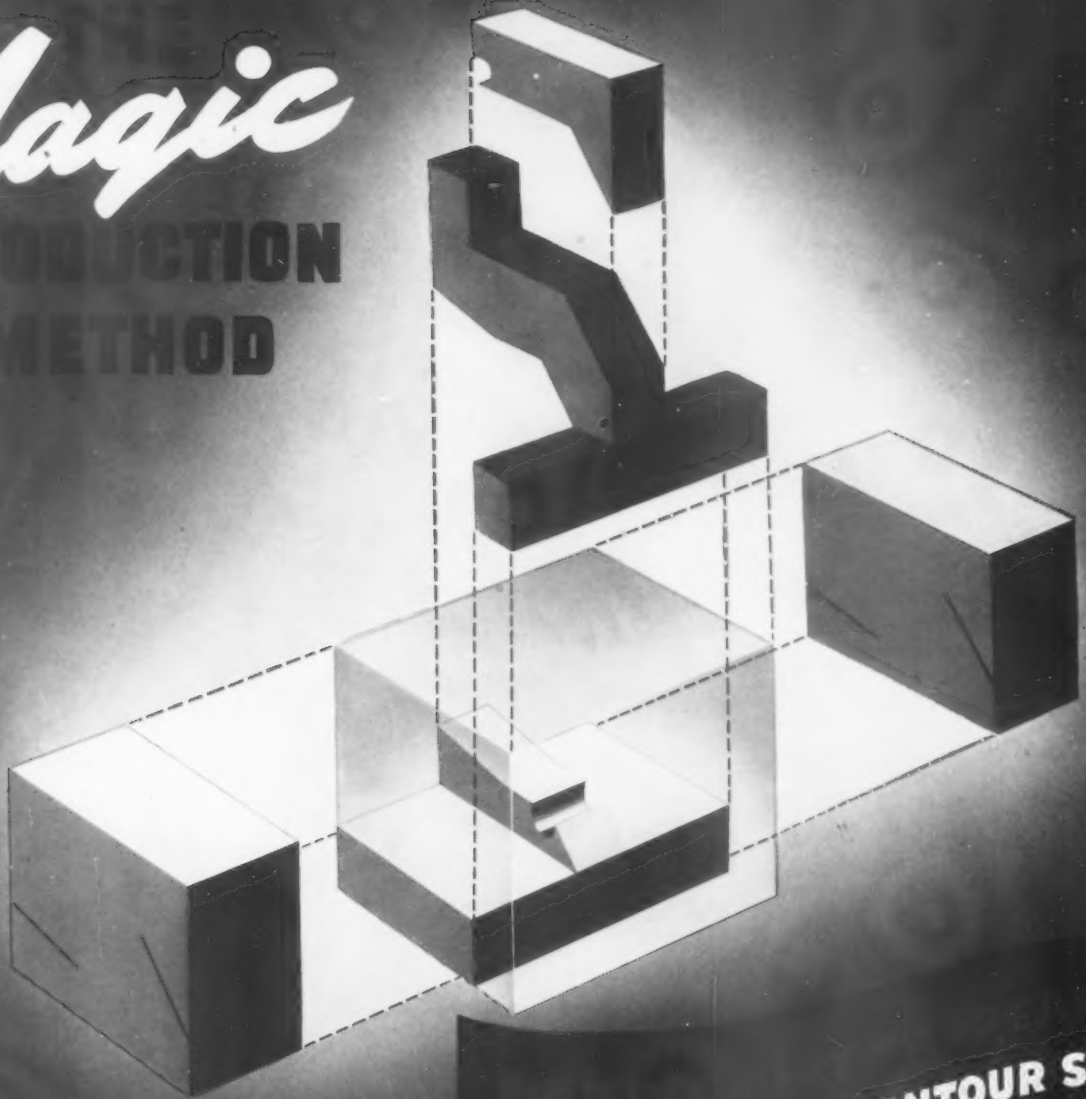
CONVENIENT OPERATION permits control of machine from either front or rear. Power feed providing 6 longitudinal table speeds and wet grinding are available.

GRAND RAPIDS
MANUFACTURED BY
GALLMEYER & LIVINGSTON CO.
GRAND RAPIDS, MICHIGAN, U.S.A.

What "GRAND RAPIDS" Quality Means: G & L cast their own close-grained gray iron, machine all parts to micrometric tolerances, and precision-assemble grinding machinery of unsurpassed performance. *Grand Rapids* means *top* quality in grinding machinery.

GALLMEYER & LIVINGSTON CO., 110 STRAIGHT ST., S. W., GRAND RAPIDS 4, MICH.

Magic PRODUCTION METHOD



CONTOUR SAWING

Contour Sawing is the *world's fastest metal removing process*. Hundreds of sharp, hard tool points on endless band "slice" off unneeded metal — no slow "whittling" to worthless chips. Continuous cutting; no backstroke or lost motion. Apprentice can cut accurately within .005".

Above 3-dimensional part, contour-sawed on a DoALL by Royal Typewriter Co. Hartford, Conn. Countless other jobs are similarly produced from stock instead of being cast or forged and machined by ordinary methods. All metals, even tough alloy steels, a foot or more thick, are precision cut on a Contour Saw.

Amazing advantages of Contour Sawing are pictured in free booklet *"DoALL Equals Ten Plus"*. Write for a copy to find out about real production economies.

The DoALL Company

DoALL STORES
IN PRINCIPAL CITIES

MACHINE-TOOL DIVISION
MINNEAPOLIS 4, MINN.

So GOOD it stayed for a peacetime Job

BETHLEHEM 66 High-Speed Tool Steel

The war really *proved* 66.

It proved that this high-speed tool steel could do even *more* than the straight high-tungsten types.

At lower cost, too.

And 66 *still* costs less; *still* does more. Use it in tools for lathes, planers, boring mills, slotters; use it for taps and reamers; for gear-cutters, end mills, broaches, tool bits, and similar applications.

Put it in your shop; let it prove itself for *you*.

The accompanying tables show the hardening and tempering series that induce the best properties in 66 High-Speed. The ideal quenching temperature for cutting tools is seen to be 2250 deg. F., with 3 minutes the optimum holding time for greatest refinement and hardness.

HARDENING SERIES (1-inch-square bar stock)

		OIL QUENCH		AIR QUENCH	
Quenching Temp.	Holding Time	Fracture Grain Size	Rockwell Hardness	Fracture Grain Size	Rockwell Hardness
2100	3 min.	9½	64	9½	63
2200	3 min.	9¾	66	9¾	65.5
2250	3 min.	9¾	66	9¾	65.5
2275	3 min.	9¼	66	9½	65

***TEMPERING SERIES** (1-inch-square bar stock)

QUENCH TEMP. 2250 DEG.

	OIL QUENCH	AIR QUENCH
Drawing Temperature	Rockwell Hardness	Rockwell Hardness
850	63.5	63.5
900	65	64
950	66	65
1000	67	65.5
1050	64.5	62.5
1100	64	61.5
1150	62	60

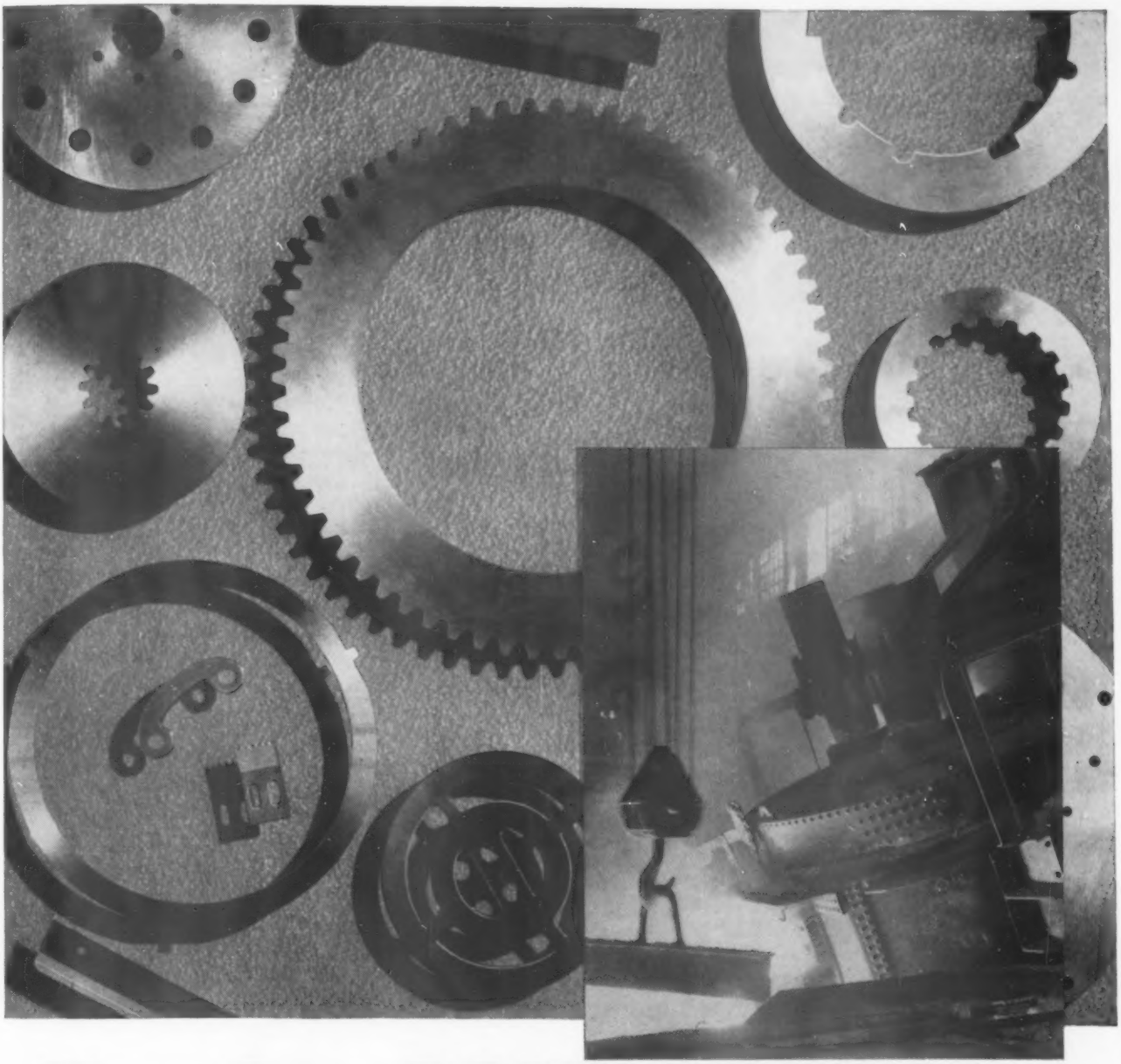
** Single-tempering operation. Double tempering is always recommended for maximum properties in high-speed steel.*

TYPICAL ANALYSIS

C	Mn	Si	Cr	W	Mo	V
.84	.30	.30	4.20	6.50	5.00	1.90

★ ★ ★ BETHLEHEM STEEL ★ ★ ★

66 *High-Speed*... one of Bethlehem's BIG 8 Tool Steels



You Can POUR YOURSELF
any Flat Steel Specialties you want

FROM

SIMONDS

ELECTRIC

STEEL

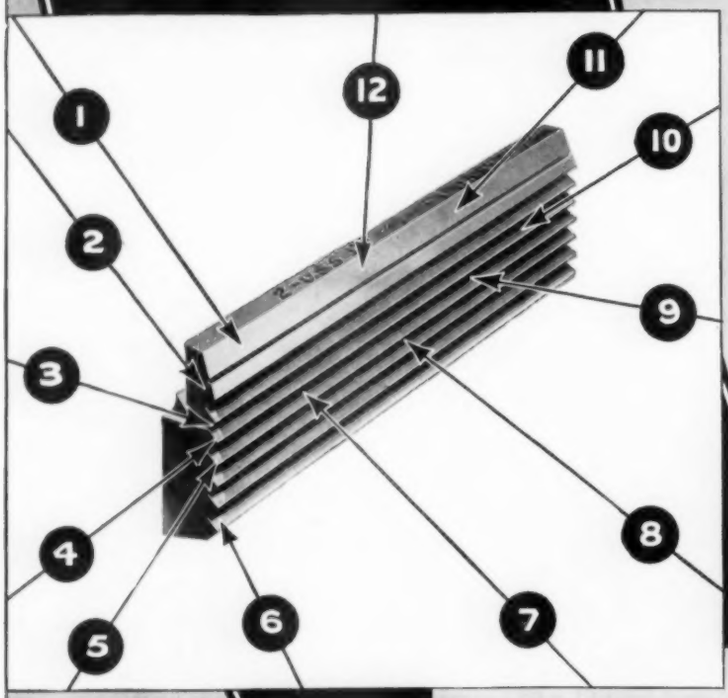
Yes, you can get any special shapes you want, hardened and ground, with edges square or bevelled. Just send your blueprints or specifications to Simonds . . . and you will have them met promptly and exactly . . . with steel from Simonds modern electric mills, machined and finished in Simonds controlled-conditions plant. Send your specs or blues along *today*, to the nearest Simonds office listed below.

BRANCH OFFICES: 1350 Columbia Road, Boston, 27, Mass.; 127 S. Green St., Chicago 7, Ill.; 416 W. Eighth St., Los Angeles 14, Calif.; 228 First St., San Francisco 5, Calif.; 311 S. W. First Avenue, Portland 4, Ore.; 31 W. Trent Avenue, Spokane 8, Washington. *Canadian Factory:* 595 St. Remi St., Montreal 30.

SIMONDS SAW AND STEEL CO.
FITCHBURG, MASS.

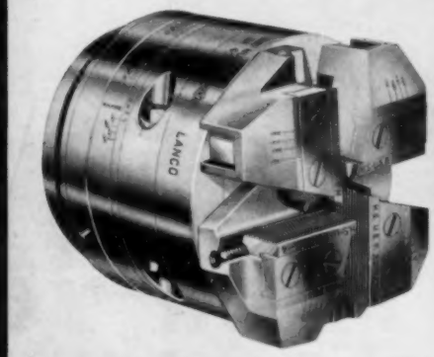
Acclaimed..

The Finest Thread Cutting Tool in Industry



The LANDIS CHASER

Used Exclusively in LANDIS Die Heads and Threading Machines



1-Permanent throat permits close to shoulder threading throughout life of chasers

2-Rake angle range covers all machinable materials

3-Free cutting condition permits maximum cutting speeds

4-Simple grinding operation renews entire cutting edge and leading feature

5-Line contact with work lessens friction and minimizes thread distortion

6-Leading feature insures thread of accurate lead

7-Lateral absorption of cutting strain reduces vibration and chaser breakage

8-Right and lefthand threading feature reduces chaser equipment

9-Standard chasers thread all diameters with proper chaser holders

10-Interchangeability of chasers lowers operating cost

11-Chaser length provides exceptionally long life and low tool cost

12-Permanent throat gives equal distribution of cut

The life of the Landis Chaser, due to its design which makes it possible to machine the thread form along the entire length of the chaser, is from ten to twenty times that of the hobbed type die.

The cutting edge is renewed completely at each regrinding thereby maintaining the original accuracy of the chaser. The throat is not altered by regrinding and therefore permits close-to-shoulder threading throughout the life of the chaser.

Landis Chasers are interchangeable—any one of a set may be replaced.

LANDIS MACHINE CO. Waynesboro, Pa.

BAYFLEX...a new Bay State development

THE AMAZINGLY SAFER CUT-OFF WHEEL

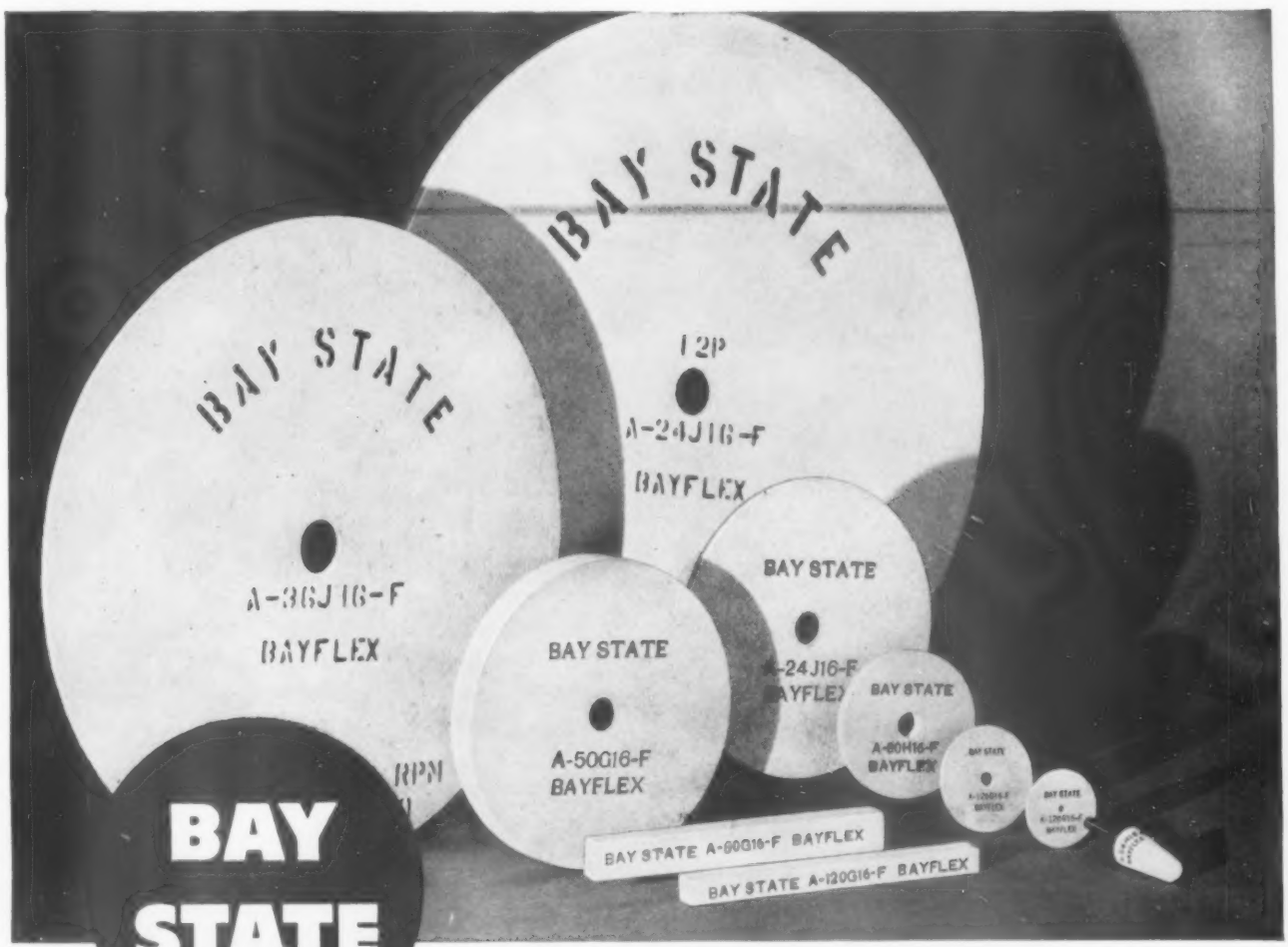
The New Bayflex Wheels, incorporating cotton fibres in abrasive bonding, are Bay State's answer to the demand for cut-off wheels that combine *greater safety* with *faster, freer* cutting action and minimize the operator's fear of wheel breakage.

Greater safety results from the increased toughness and balanced flexibility of an entirely new bonding material. And in addition to providing fast cutting, this balanced flexibility permits side grinding and close following of contours with the danger of wheel breakage greatly reduced — an amazingly safer wheel.

Already, in many foundries and other metal-working plants, these advanced wheels are setting new performance records in cutting-off non-ferrous metals. Write for recommendations on how the new safe-operating, time-saving Bayflex Wheels can benefit *your* production.

BAY STATE ABRASIVE PRODUCTS CO.

9 Union Street, Westboro, Mass.



BAY STATE ABRASIVE PRODUCTS

Top Performance Consistently Duplicated

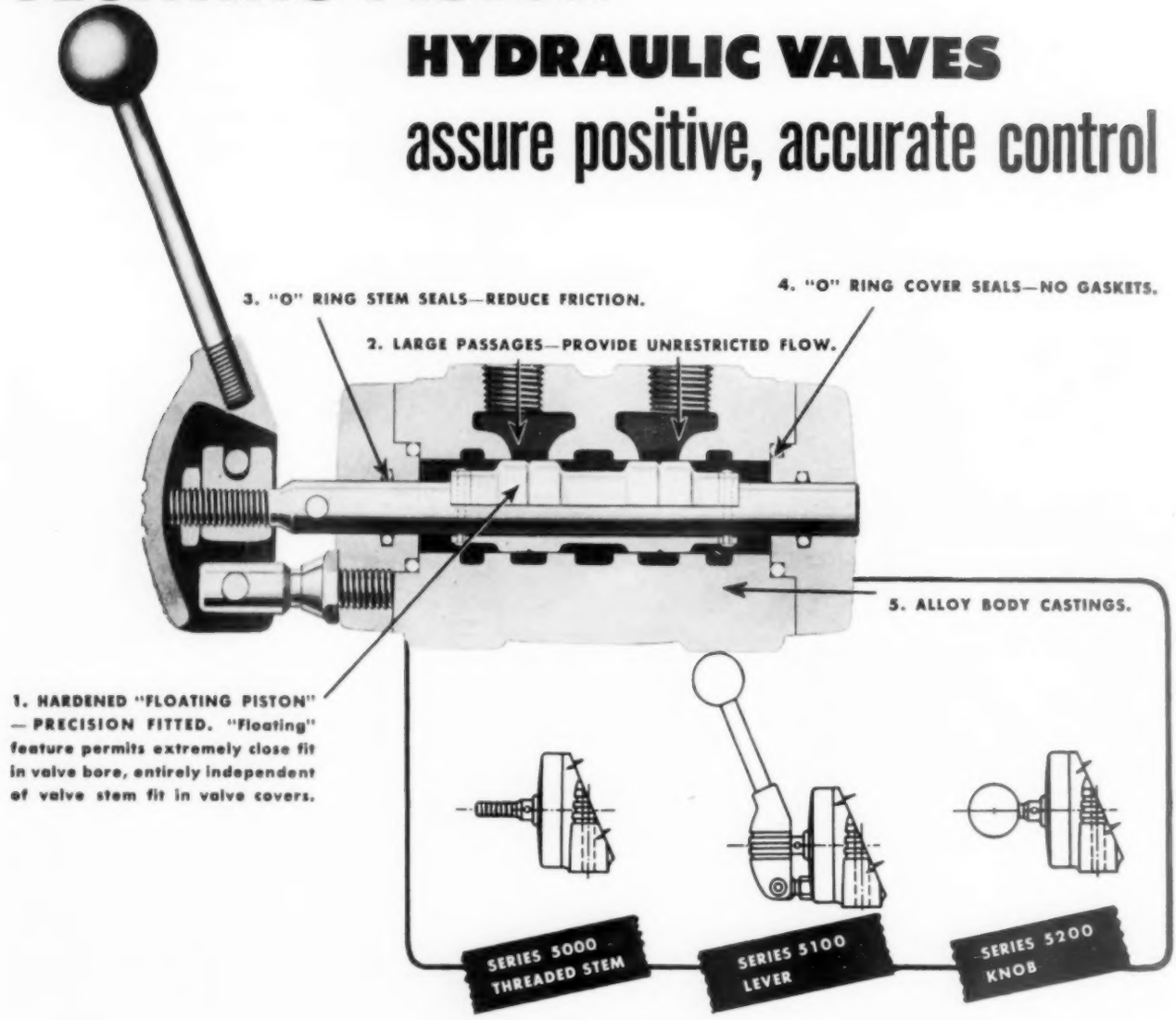
GRINDING WHEELS · HONING AND SUPERFINISHING STONES · PORTABLE SNAGGING WHEELS
MOUNTED WHEELS AND POINTS · CUT-OFF WHEELS · INSERTED-NUT DISCS AND CYLINDERS

GEROTOR

"FLOATING PISTON"

HYDRAULIC VALVES

assure positive, accurate control


3. "O" RING STEM SEALS—REDUCE FRICTION.
4. "O" RING COVER SEALS—NO GASKETS.
2. LARGE PASSAGES—PROVIDE UNRESTRICTED FLOW.
5. ALLOY BODY CASTINGS.
1. HARDENED "FLOATING PISTON" — PRECISION FITTED. "Floating" feature permits extremely close fit in valve bore, entirely independent of valve stem fit in valve covers.
SERIES 5000 THREADED STEM
SERIES 5100 LEVER
SERIES 5200 KNOB

For dependable oil service, involving pressures up to 3000 p.s.i., specify Gerotor "floating piston" 4-way hydraulic valves. They are made in seven sizes with five different piston designs, meeting the requirements of any hydraulic circuit. Available methods of operation are: Hand, Foot, Cam, Solenoid, Oil Pilot Pressure, and Air Pilot Pressure.

Advanced design, efficient operation, expert manufacturing . . . these are characteristics of every hydraulic valve by Gerotor.

GEROTOR MAY CORPORATION • Baltimore 3, Md.

More Speed and Accuracy

IN HEAVY DUTY DRILLING!

Big and powerful—the new Defiance No. 540 Vertical Hydraulic Feed Machine offers advantages in *speed, accuracy* and *efficiency* for heavy duty single or multiple spindle drilling, boring, reaming, or milling operations.

The machine shown here has a 28-spindle head and fixture for drilling 11/16″ holes in large diameter plates ¾″ and ⅜″ thick. For this operation, the machine has a 42″ three station indexing table. The column is a heavy-type cored casting with long ways which carry the head slide. Weight of machine, 39,150 lbs.

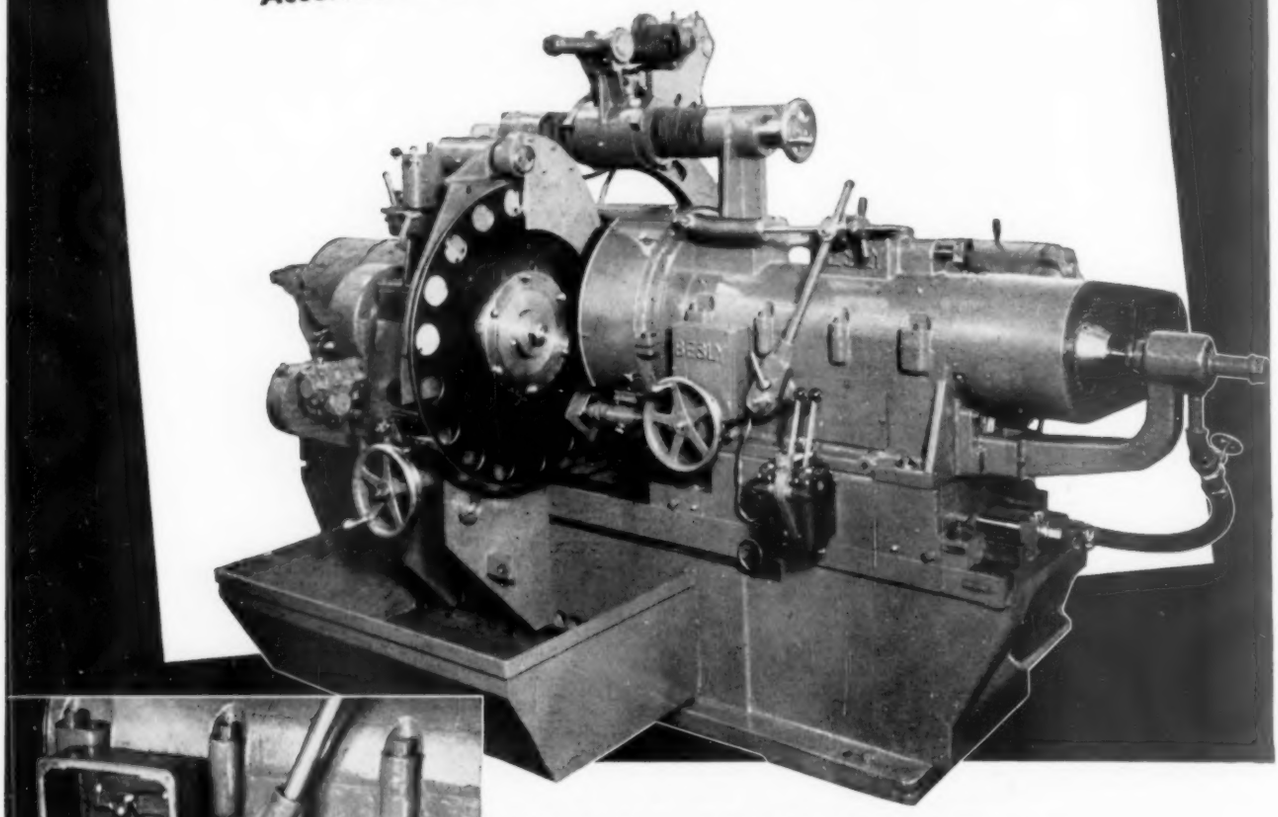
Built with the know-how of 96 years . . . traditional Defiance accuracy and dependability. Write for bulletin. Defiance Machine Works, Inc., Defiance, Ohio.

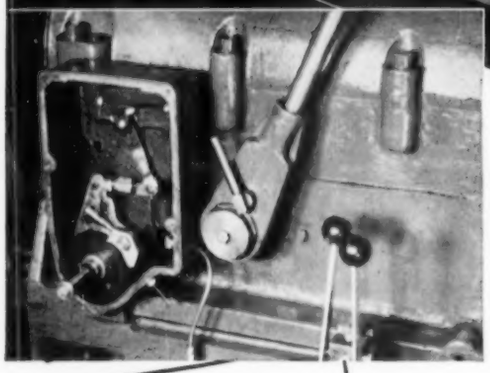
DEFIANCE

96 YEARS OF PRECISION MANUFACTURING

Now.. 400 GEAR BLANKS AN HOUR

Accurate for Size, Flatness, Parallelism and Finish!





Above: No. 226, 30" Besly Double Spindle Grinder with rotary feed for grinding gear Blanks plates of Monel Metal and Meehanite.

At left: Close-up of hydraulically-operated control conveniently located for fine wheel adjustments. Grinding wheels can be adjusted up to .0001 if desired.

BESLY GRINDERS

If you are buying
BESLY GRINDERS
from U. S. Government Surplus Stocks
ask us to help you select and adapt such machines to meet the specific needs of your production.

In the production of cover plates and gear blanks for a 2-stage fuel unit pump, Besly's "226-30" Grinder produces 400 finished pieces an hour within a tolerance of .0002 for parallelism, flatness and size—under a ten micro-inch finish. Total stock removed is .70" to .090"—at rate of 1,600 passes an hour—four passes required per piece. Former method gave less than half this production without close tolerance for flatness, parallelism and finish. Besly Grinders are easily adapted to a wide variety of specialized production.

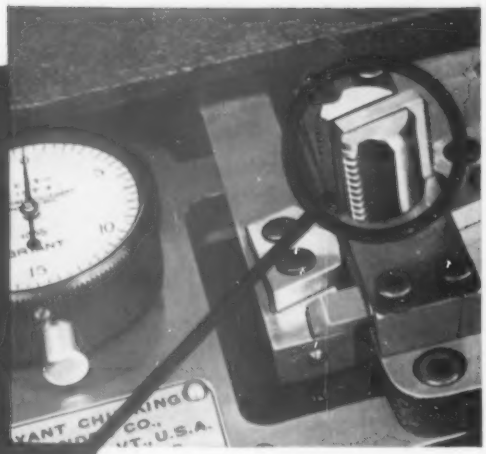
Besly engineers will galdly help you to select the right grinder to do your work with speed and precision—*at the lowest cost possible. Why not look into the possibilities? Write today.*

BESLY

BESLY GRINDERS AND ACCESSORIES
BESLY TAPS • BESLY TITAN ABRASIVE WHEELS

CHAS. H. BESLY AND COMPANY, 118-124 N. Clinton St., Chicago 6, Ill., Factory: Beloit, Wis.

Quality Control made simple ...by the use of BRYANT THREAD GAGES



Internal

External

Quality control — essential to mass production of threaded parts — often slows assembly lines, when time-consuming, conventional gaging methods are used. Yet, inspection can be simple, accurate to any desired tolerance, and extremely fast if you use Bryant Thread Gages. They are easily operated at top speed by anyone. The operator need only squeeze the control lever, drop the part onto the work holder, release the lever. An immediate engagement is made on all the threads. He gives the work a partial turn and the thread is inspected all over. The dial indicator shows the overall accuracy within required tolerances, or accumulated inaccuracies of lead, pitch, diameter and thread form or the presence of burrs. And no "feel for fit" is required and these gages are four-to-five times faster than ring and plug gages.

Do you value quality control in your plant? Then send us part prints covering your problems — our engineers will be glad to advise you. Send the coupon below for Illustrated Catalog G-3.

New Portable Thread Gages, also Squareness of Face Gages, Universal Diameter Size Gages.

Please send me Catalog No. G3 which gives complete details on the Bryant Thread Gages.

Name_____ Title_____

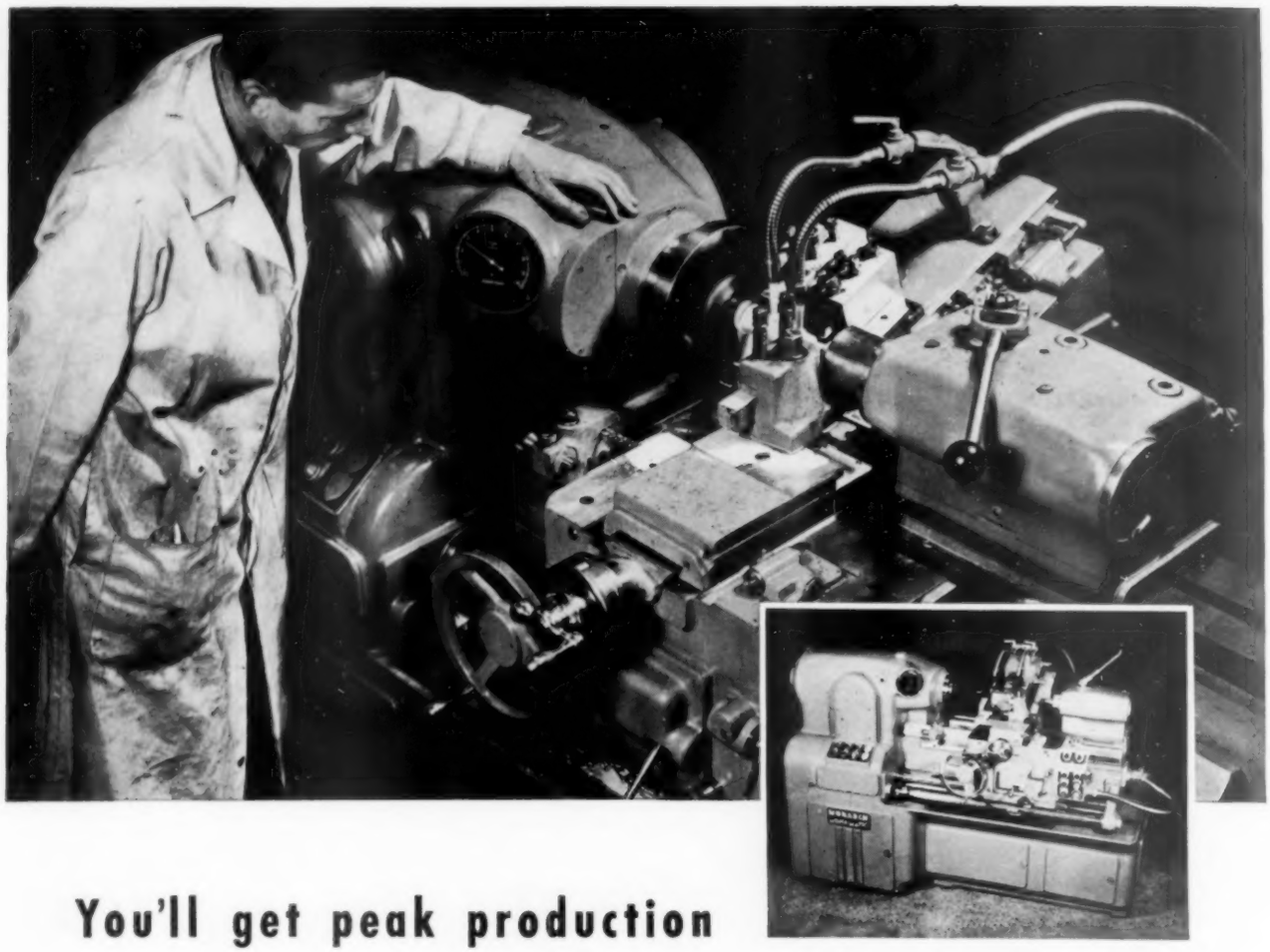
Company_____

Street_____

City_____ State_____

BRYANT

BRYANT CHUCKING GRINDER CO. SPRINGFIELD, VERMONT, U. S. A.



You'll get peak production

AT A PROFIT — with the *Mona-Matic**

Fully automatic cycle—or fully manual—or any combination. Between-centers work as fast as carbide tools and modern metals can take it—spindle speeds up to 1000, 2000, 3000 and even 5000 RPM.

That's the kind of work you can do on the Mona-Matic. Regardless of exacting tolerance requirements, you'll get floor-to-floor time you'd ordinarily think of only in connection with specialized one-purpose machines—and at the corresponding low machining costs usually restricted to mass production methods.

Yet with the Mona-Matic you'll have an almost universally adaptable machine—one you can use on big lots and small, year in and year out. The front carriage is built with power feed and rapid traverse return; the independent electrically controlled rear slide may be added as a separate unit.

* **MONA-MATIC** — Add this new name to your metal-turning dictionary — You'll be hearing a lot of it — wherever rising production costs are a factor. The *Mona-Matic* is Monarch's answer to this problem in the field of between-centers work. For chucking and fixture work it's the *Uni-Matic*; for hand screw machine work the *Speed-Matic*.

Get full details on these three new machines *now* — from your nearest Monarch representative — or write us direct.

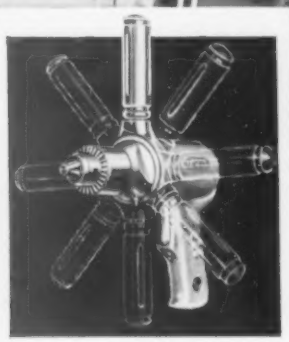
The Monarch Machine Tool Co. · Sidney, Ohio

ACCURACY · ECONOMY · LONG LIFE

Monarch

TURNING MACHINES

NEW ½" DRILL



Model 7016 includes an auxiliary handle (shown in operator's left hand) that can be instantly located in any position—it revolves around the nose of the tool.

FASTER PRODUCTION

Here's big power and accuracy for heavy duty, continuous-production drilling—yet this new ARO Model 7016 Air Drill is *40% lighter in weight* than other drills of same capacity!

This big difference in weight makes the ARO ½" Drill easier to handle and greatly reduces operator fatigue. Geared for the correct speed-and-power combination in relation to its capacity—providing a capable, stall-proof answer to all jobs of drilling, reaming and countersinking.

Has ¼" pipe opening in handle . . . built-in automatic oiler . . . built-in speed regulator and safety trigger. 1000 R.P.M. ARO-built for long life and trouble-free performance. Write for catalog. The Aro Equipment Corporation, Bryan, Ohio.

There is an Aro Jobber near you.

ARO

PNEUMATIC TOOLS

MIDVALOY STAINLESS BARS

Among the most widely useful of all stainless steels are the hardenable straight chromium types. Midvale has been making them regularly for many applications. Bars in this category produced at Midvale include low and high carbon varieties in both free-machining and non-free-machining grades. Available in hot or cold finished form, most types are carried in stock in the popular sizes, shapes and finishes.

THE MIDVALE COMPANY • NICETOWN • PHILADELPHIA

OFFICES: NEW YORK • CHICAGO • PITTSBURGH
WASHINGTON • CLEVELAND • SAN FRANCISCO

One of eight plants to retain original Navy "E"

MIDVALE

Custom Steel Makers to Industry

WHEN IS A MACHINE *"Washed Up"?*

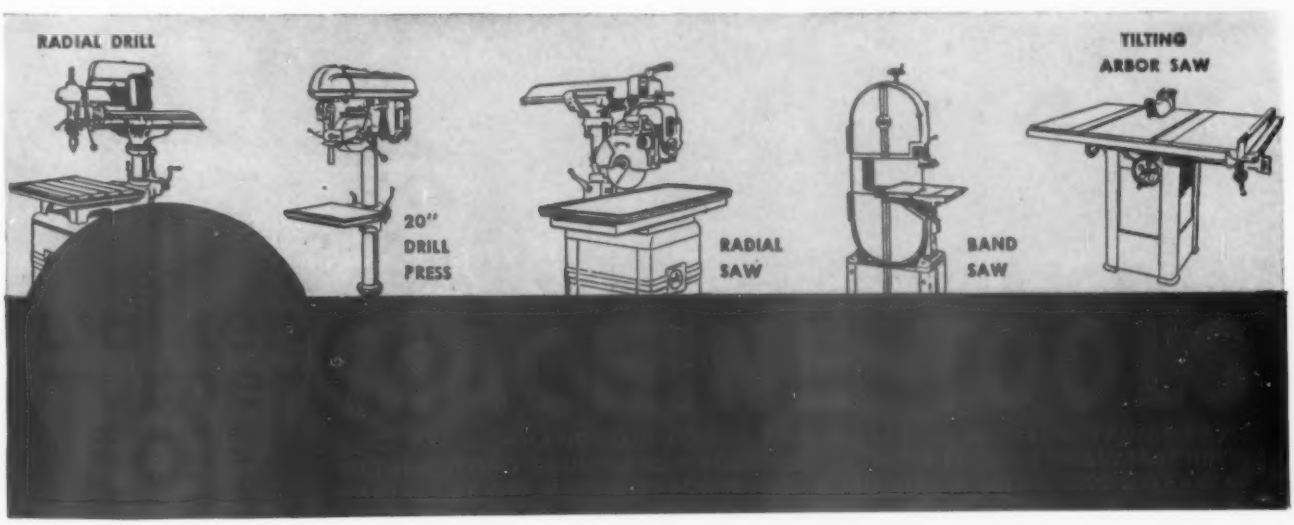
In seven years some say—but in modern production practice it is not a question of years or how much the machine has earned or still owes you. The question is, will your equipment enable you to compete with the new, faster working, more efficient and flexible layouts in your competitors' plants.

A five-year-old Machine Tool is "washed up", for instance, if it can be replaced by one costing a few hundred dollars that will write itself off in less than a year through improved production. That's the story of Walker-Turner Machine Tools wherever metals, wood or plastics are drilled, cut or shaped.

These machines are "light" only in weight and price. Their production output in the past eight years has astounded the management of thousands of plants—large and small—throughout the country.

A key to high manufacturing efficiency and **low manufacturing costs** is the modern, flexible, light machine tool. It represents small capital investment, flexibility of operation, increased productivity and low operating costs.

Walker-Turner Machine Tools are sold only by authorized Industrial Machinery Distributors. A general catalog will be sent on request.



CUSHMAN CHUCKS

A World Standard for Precision

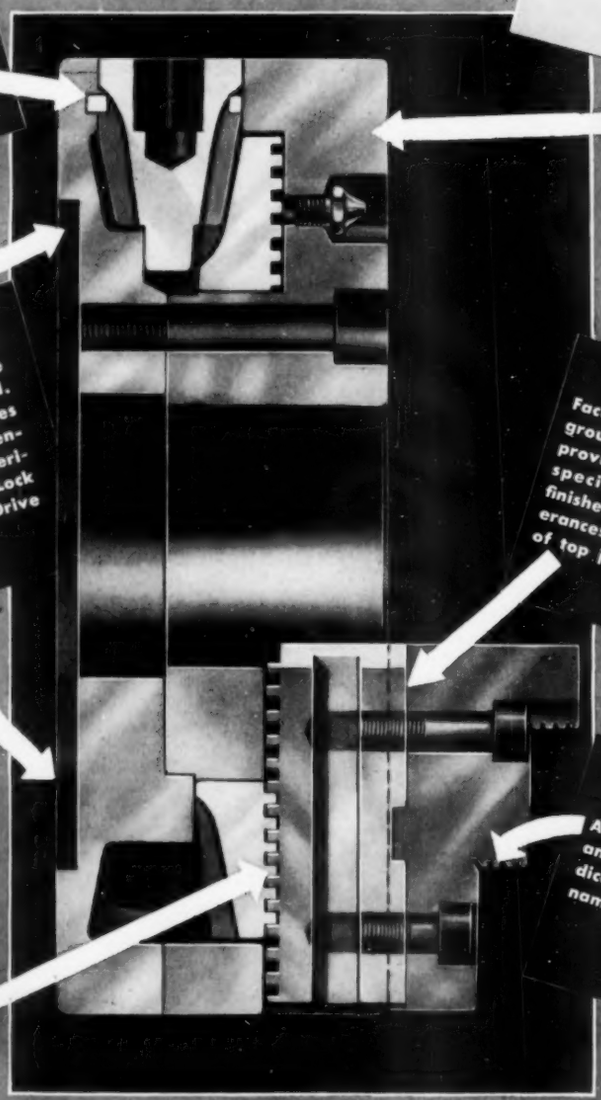
Here are some of the reasons why!

Pinions of hardened special analysis steel with tooth form processed to provide accurate alignment with the scroll gear.

Chuck bodies engineered to assure solidity, stiffness and jaw support and alignment without excess weight. Mounting faces precision machined.

Counter bore recess of bodies finished to extreme accuracy to guarantee correct alignment when mounted. Pratt & Whitney Electrolimit gages are used for testing these dimensions for Chucks designed for American Standard Type A-1, Cam Lock Type D-1 or Long Taper Key Drive Type E mountings.

Face of master jaws hardened and ground after assembly in chuck to provide accuracy in alignment of special top jaws. Cross key slot finished to American Standard tolerances providing accurate location of top jaws.



Scrolls of self centering chucks are cut on our own specially designed machines after heat treatment. This method insures precision lead of scroll thread and toughness to withstand chucking stresses.

Accuracy of finished chucks tested and held to within .003" total indicator error. Chuck bodies dynamically and statically balanced.

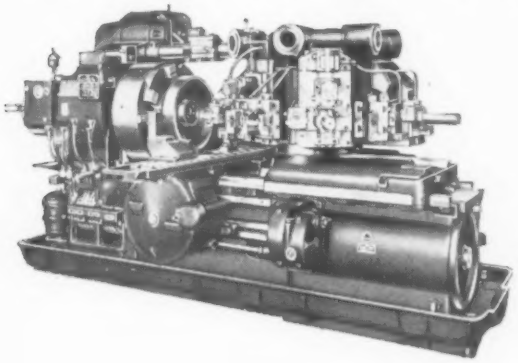
THE CUSHMAN CHUCK CO., HARTFORD 2, CONN.

CUSHMAN CHUCKS

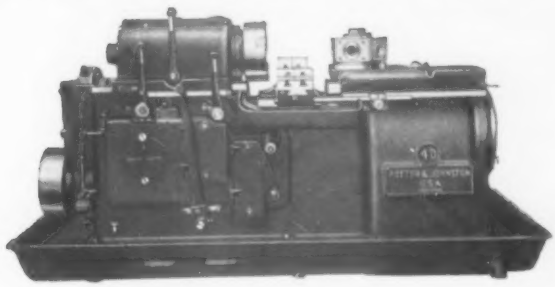
A WORLD STANDARD FOR PRECISION

P&J AUTOMATIC CHUCKING *and* TURNING MACHINES

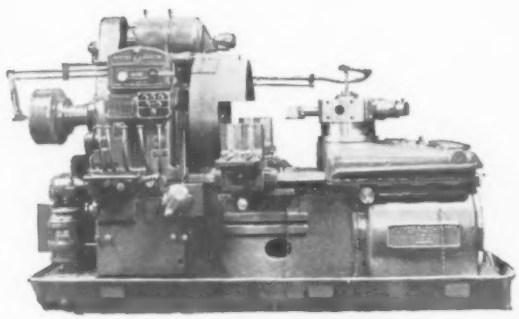
Leaders in their field for more than 40 years



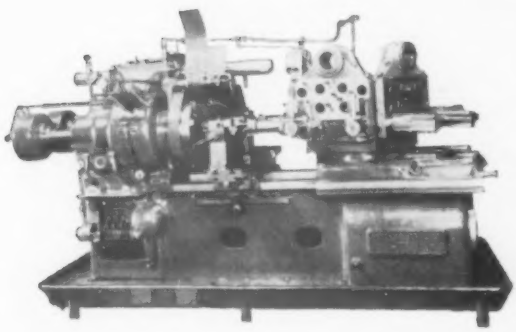
P&J 8DT and 8DXT Automatic



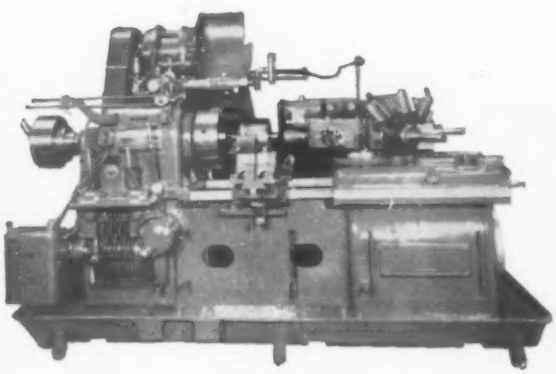
P&J 4D Automatic



P&J 6D REL and 6D REELX Automatic



P&J 5D Two Spindle Power-Flex Automatic



P&J 5D Power-Flex Automatic

BUY THOSE EXTRA
VICTORY BONDS NOW!

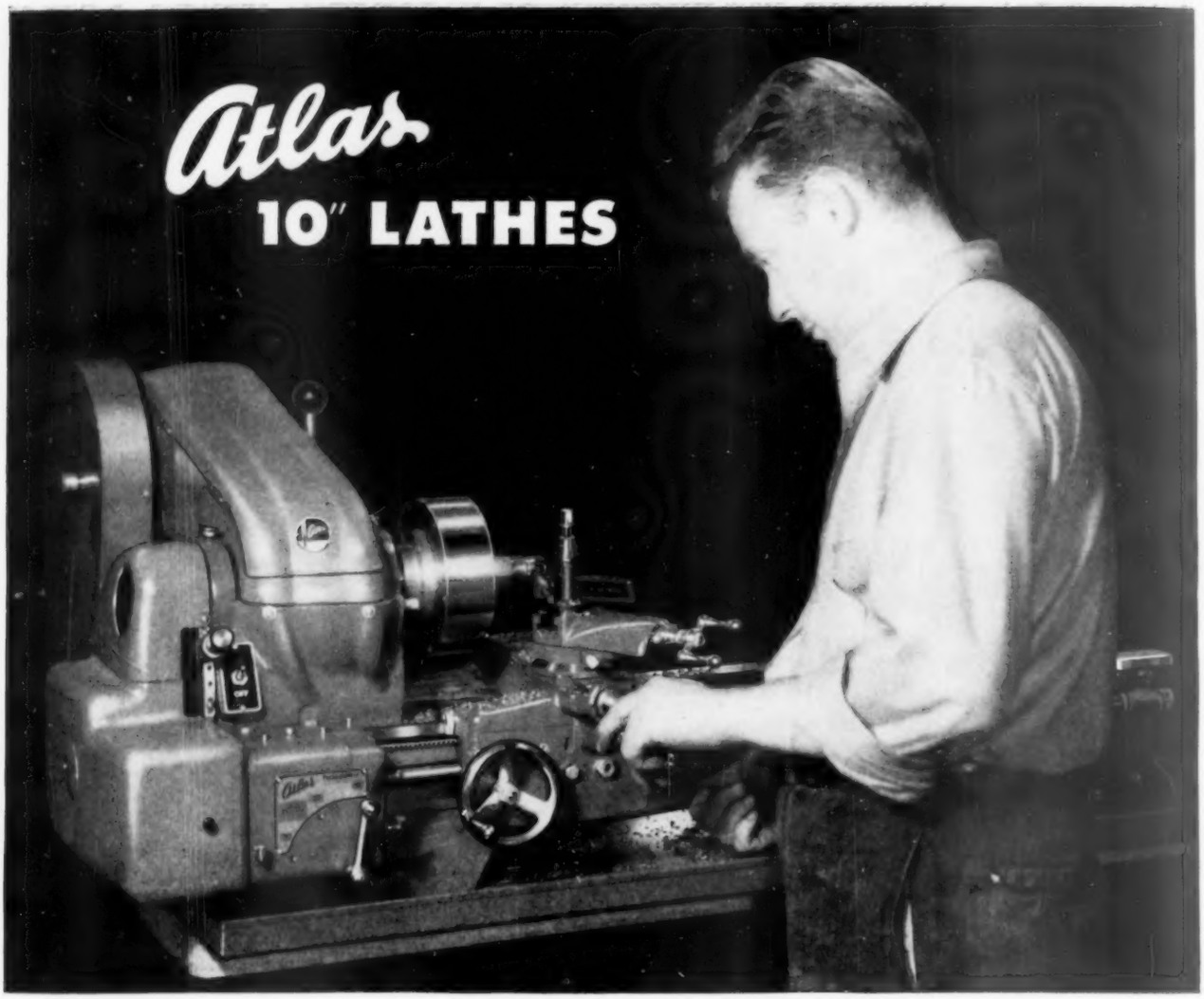
The complete line of P&J Manufacturing Automatic Chucking and Turning Machines covers practically all requirements for size range of work. High accuracy, fast work and convenience in handling are assured whether parts produced are small or large. Every machine regardless of capacity, can be tooled and re-tooled to provide the utmost in flexibility for meeting specific machining requirements.

P&J engineers are available to help you with your production problems. Ask for descriptive literature covering P&J machines.

Authorized Agent, U. S. War Assets Corporation

POTTER & JOHNSTON MACHINE COMPANY

Pawtucket, R. I.



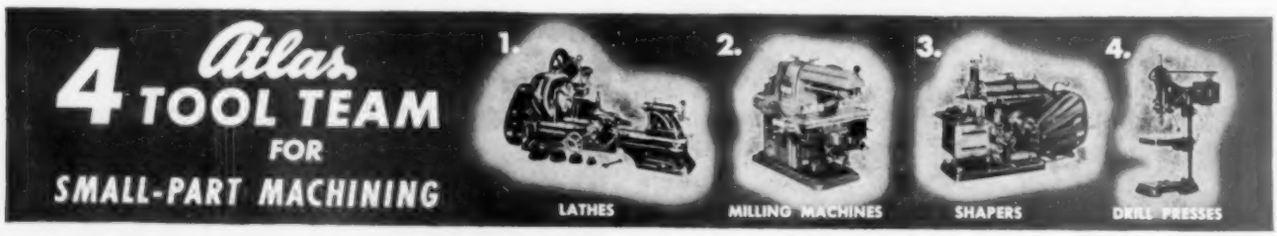
CUT MACHINE-HOUR COSTS

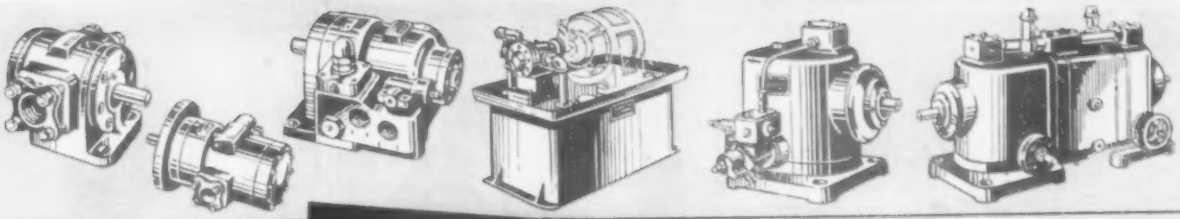
More economical to buy and more economical to operate, Atlas lathes can cut costs substantially in your tool room or on the production line. By adopting the Atlas idea of "match the machine to the job" you can end wasting the capacities of costly machines on small parts operations.

Atlas lathes give you a 10½" swing over the bed—6⅝" over the carriage—up to 36" between centers. There are 16 spindle speeds 28 to 2072 RPM. Thread cutting range is 4 to 96 per inch. Power cross and longitudinal feeds. Timken bearings. Tailstock turrets, Multi-Stops, and lever-type collet chucks quickly convert standard lathes to hand screw machines.

With man-hour costs rising the only way right now to keep prices competitive is to cut machine-hour costs. Send today for latest catalog with complete specifications and prices.

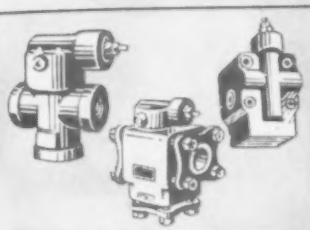
ATLAS PRESS COMPANY
714 North Pitcher Street, Kalamazoo 13D, Michigan

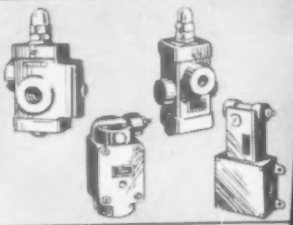


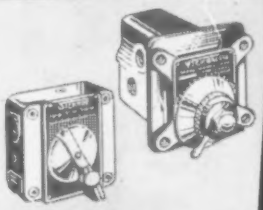


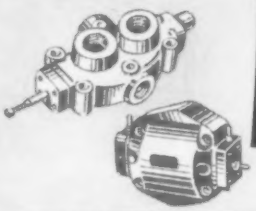
VICKERS

THE MOST COMPLETE LINE of HYDRAULIC PUMPS and CONTROLS

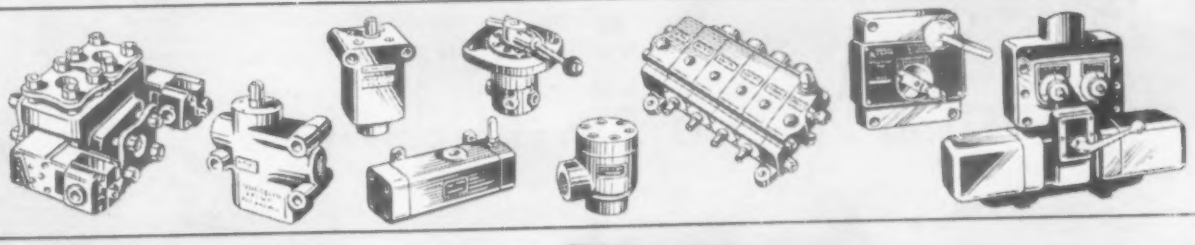


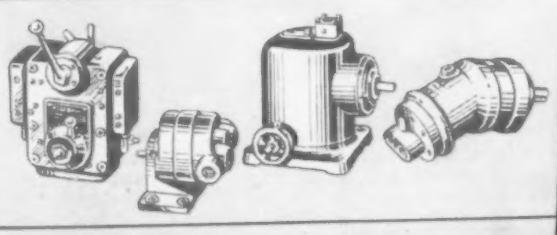






Constant delivery vane type pumps, variable delivery piston type pumps, power units, pressure controls, volume controls, directional controls, cycle control panels, fluid motors, variable speed transmissions . . . these are indicative of the great variety of Vickers hydraulic units. Having the most extensive line of hydraulic equipment, Vickers can meet all hydraulic requirements and provide the important benefits of undivided responsibility. Vickers Application Engineers will be glad to discuss with you how hydraulics can be used to your advantage.





There are more than 5000 Standardized Vickers Units that can be used in various combinations to exactly supply Every Hydraulic Power and Control Function

ANY FEED RATE • ANY TRAVERSE RATE • ANY RPM

ANY SEQUENCE OF MOTIONS • ANY ACCELERATION OR DECELERATION • ANY THRUST . . . . . .

VICKERS *Incorporated*

1432 OAKMAN BLVD. • DETROIT 32, MICHIGAN

Application Engineering Offices:

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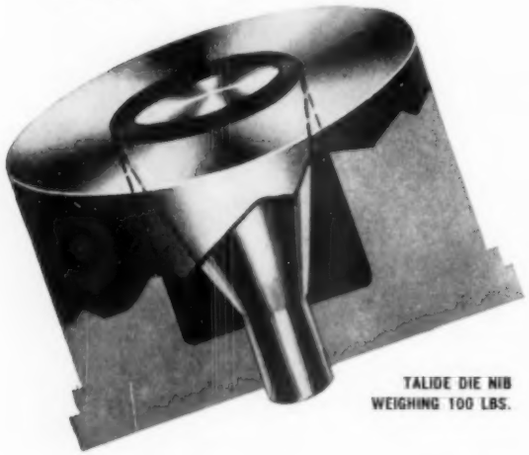
Talide
(TUNGSTEN CARBIDE)

Performance!

OVER *3,000,000* Impressions from one TALIDE DIE



TALIDE DIE NIB WEIGHING 100 LBS.

Here's a cold forming job on alloy steel forgings 4¼" dia. x 15⅜" long which requires more pressure and generates greater friction than steel dies can take in one operation.

By replacing steel with a Talide Tungsten Carbide Die, the projectiles were swaged in one operation. Two operations were needed with steel dies. After three million impressions, the smooth, highly finished, large Talide Die needed no redressing. And in each of the three million, the operators reported complete elimination of galling, scratching and pick-up.

Talide Dies can be used for any cold working operation where steel dies wear out too fast or on applications too severe for steel dies. Metal Carbides make Talide Dies in all sizes up to 24" diameter, I.D.

Complete information on TALIDE Tungsten Carbide Dies is given in Bulletin 43-WP . . . write for a copy.

TUBE MANDREL

DRAWING DIES
(For Wire, Tubing and Bar Stock)

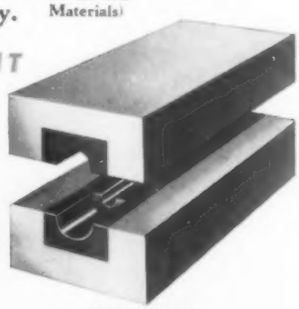
POWDER METALLURGY DIES
(For Compacting Powdered Metals and Materials)

TALIDE METAL MEETS EVERY REQUIREMENT

BLANKING AND FORMING DIE
(For Stamping Lamination Discs, Metals, Plastics, Paper)

SHEET METAL DIES
(For Deep Drawing Metal Products)

HEADING AND EXTRUSION DIES
(For Shaping and Sizing Bolts, Nuts, Screws, and Rivets)



SWAGING DIES
(For Forming Solid and Tubular Shapes)

THE ENGINEERED CARBIDE FOR ALL APPLICATIONS

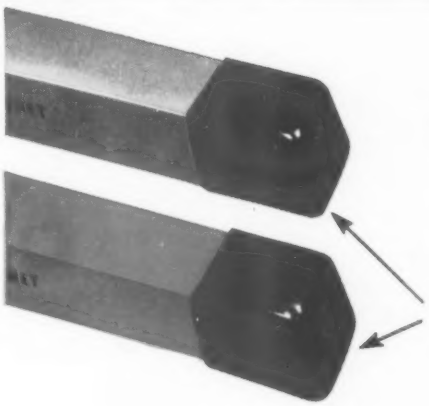
TALIDE

METAL CARBIDES CORPORATION

YOUNGSTOWN 5, OHIO *Pioneers in Tungsten Carbide Metallurgy*

SINTERED CARBIDES FOR CUTTING • HOT PRESSED CARBIDES FOR DRAWING AND WEAR RESISTANCE

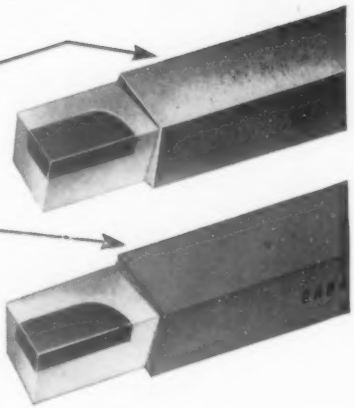
CARMET
Carbide Tools and Tips



★ **Blue Shanks for Iron and Non-Ferrous Metals**

★ **Red Shanks for Steel Cutting.**

★ **Wax Caps Protect Tips in Stock and Transit**



EFFICIENTLY BOXED

Carmet sintered carbide tool bits are packed for shipment in strong, metal-reinforced boxes of distinctive design. The grade, size and number of pieces are marked on each end of the box, for convenience on your stock shelves.

EASY TO IDENTIFY

In addition to the box marking, and to the shank coloration (see above), each Carmet tool bit is stamped with the name and grade number . . . your stock clerks and machine operators can't mistake them.

All the Data on **CARMET**

Send for your copy

The 16-page Carmet Catalog contains full data on types, grades, sizes and applications of standard blanks and tools; information on special sizes, tool shank steel, etc. Write for it today.

ADDRESS DEPT. TE-43

TOPS IN CUTTING PERFORMANCE

Carmet carbide tips are produced by advanced techniques, under conditions of rigid control that maintain complete uniformity to type and grade. These carbide tools can show you tremendous increases in cutting speeds, and corresponding improvements in your finishing costs. ● Let our Service Engineers work with you to fit Carmet tools into your operations.

ALLEGHENY LUDLUM

STEEL CORPORATION · General Offices, Pittsburgh 22, Pa.

Pioneer in Specialloys

SIMPLEX

The shop which builds a variety of products in varying size lots, needs something much more flexible than the conventional type of precision boring machine. It must be able to handle jobs both large and small with a minimum of set-up and change-over time. It must be quickly aligned, equipped with an accurate method of spacing holes and a quick means of changing speeds and feeds.

THE BORING MACHINE FOR A THOUSAND JOBS

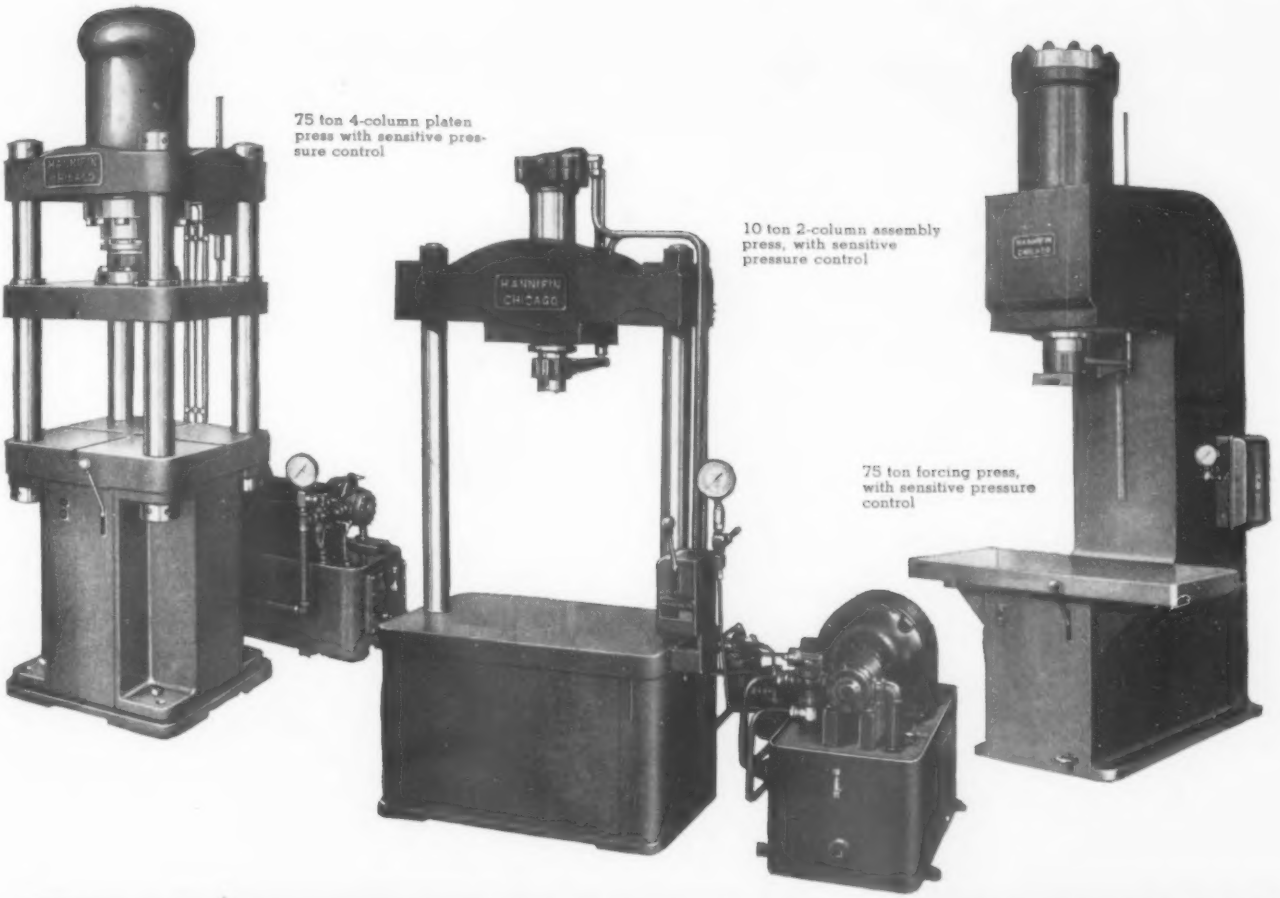
A SIMPLEX 3U Knee Type Precision Boring Machine is here shown with an indexing fixture for precision boring several parts in a heavy transmission. The hole sizes differ, so a quick means of changing speed is of great advantage. Various fixtures are used which can be made of the most desired proportions and the machine adjusted to suit the work. Boring and facing feed changes are quickly and conveniently made by means of the star knobs on the bed. All controls are within the operator's easy reach. One of the most valuable features is the fact that when once set up for a job, operation is reduced to loading and unloading the work and pushing the starting button. Let our representative study your work and tell you more of the many advantages of these advanced designs.

Precision Boring Machines

STOKERUNIT CORPORATION

SIMPLEX Precision Boring Machines and Planer Type Milling Machines

4528 West Mitchell Street, Milwaukee 14, Wisconsin



75 ton 4-column platen press with sensitive pressure control

10 ton 2-column assembly press, with sensitive pressure control

75 ton forcing press, with sensitive pressure control

HANNIFIN HYDRAULIC PRESSES

100 ton straightening press with long table and center type fixture

These presses are but a few of the standard and special types developed by Hannifin designers.

Straightening Presses—available from 6 to 150 tons with choice of table lengths and work holding fixtures for work that is centered or for round pieces.

Forcing Presses—from 6 to 150 tons, varying controls, stroke, gap and table construction.

Column Presses—2 or 4 column up to 150 tons, standard and special designs adapted to a great variety of production work.

Their design provides all the advantages of standardized construction, with welded frames and bases, precision hydraulic cylinders, built-in hydraulic power, perfected controls, and provision for simple installation. Flexibility to meet individual needs is readily available, as table construction, column spacing, speeds and controls, and ram stroke can be readily modified. Write for press bulletins.

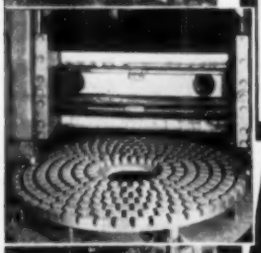
HANNIFIN MANUFACTURING COMPANY

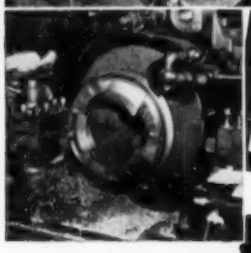
621-631 SOUTH KOLMAR AVENUE • CHICAGO 24, ILLINOIS

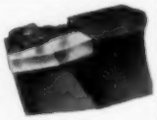
Scores of Tough Jobs Prove

KENNAMETAL K6 Machines CAST IRON *with Maximum Economy*

Kennametal Grade K6 is one of the most useful and needed recent developments in tool materials for machining cast iron and non-ferrous metals. It is an improved tungsten carbide having unusual strength in combination with exceptional abrasion-resistance and high hardness. The four performance studies outlined below are typical of scores of comparative service results that clearly show the superior properties of K6 for interrupted and continuous cutting on cast iron.







MULTIPLIES OUTPUT, ON FACING OPERATION, ON SANDY IRON CASTING

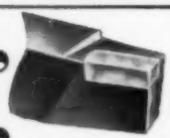
Replacing another make of carbide with a Style 11HD Tool having a clamped-on, advanceable K6 tip, made possible tripling the feed, doubling the cutting speed, and facing 8 times as many pieces per regrind. Operation—facing sandy iron castings. Feed—.036". Depth of cut—1/8" to 3/16". SFM-150 at start, 320 after tool entered cut.

REMOVES TONS OF METAL FROM CHILLED CAST IRON PARTS, AT TOOL COST OF 74 CENTS PER TON

Style 12 Tool with K6 tip turns 1⅛ lineal miles between grinds! Other makes of carbide failed at all speeds and feeds. After 10 regrinds K6 tip is used on lighter jobs. Operation—turning cast iron piston trunks, 21⅛" diameter, having six 3" or 4" ports (interrupted cut). Chilled around port holes. Very sandy surface. Feed—.09375". Depth of cut—⅛". SFM-120.

CUTS 35 PIECES (on Abrasive Electric Iron) AS AGAINST 3 FOR CARBIDE PREVIOUSLY USED

This unique tool, tipped with Kennametal K6, turns out 11½ times as much work between grinds as the carbide tool previously used. Operation—finish trepanning cut on electric iron part. Feed—.003". SFM-210. Accurate tolerances and good finish required, and produced.



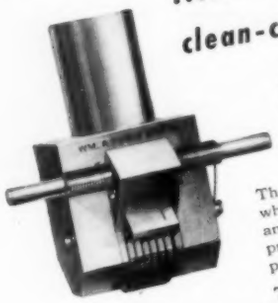
TURNS OUT 10 TIMES AS MANY PIECES, ON ROUGH CASTING, BETWEEN REGRINDS

One to four pieces between grinds was the best performance recorded by other carbides on machining a webbed flange of inferior grade cast iron, having hard spots, and sand pockets. K6 turns out more than 40! Operation—turning outside diameter and facing both sides of hub and rim. Feed—.032". Depth of cut 1/16" to 3/8". SFM-280.

The best way to prove that K6 makes possible better, faster machining on cast iron, at lower tool costs, is to try it in your own shop—then compare tool performance and overall costs. Order a few Kennametal blanks, or complete tools, now—and ask our district field engineer, who is fully acquainted with the properties of K6, to help you get maximum results from this *new* and *improved* tungsten carbide—Kennametal Grade K6.

KENNAMETAL
SUPERIOR CEMENTED CARBIDES
KENNAMETAL Inc. LATROBE, PA.

FORCE AUTOMATIC NUMBERING HEAD ...for sharp, clean-cut indenting



The Force Model 23 Numbering Head does a precision job of indenting on metal and other materials.

The deeply-engraved figure wheels cut numbers cleanly and legibly in a simple hand press or the heaviest kind of power press.

The Force Numbering Head has a *full stroke swing . . . hub-type wheels, heavy duty case, oversized ratchets and pawls.* These special Force features make the numbering head reliable and long-lasting under the severest conditions.

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How small shops expanded grinding facilities at low cost.

How large plants reduced heavy investments.

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How a single grinder can be used on half a dozen tool room jobs.

How plants saved by doing their own grinding instead of sub-contracting.

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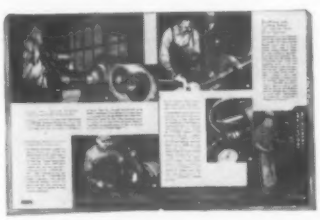
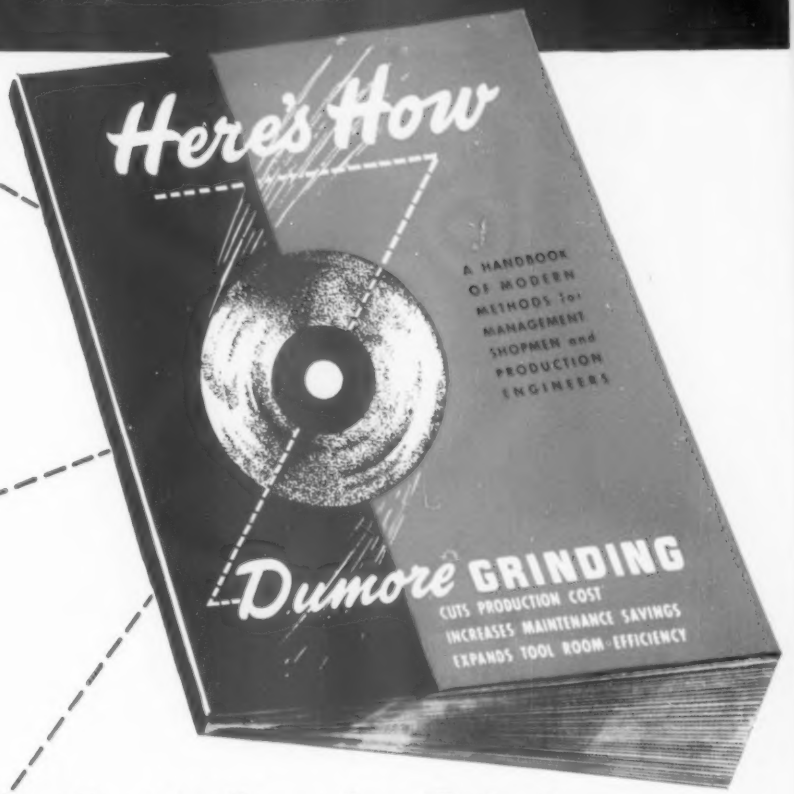


How plants cut maintenance costs by handling their own service work.

How a Dumore mounts on any standard machine tool to handle many jobs.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A HANDBOOK OF MODERN METHODS for MANAGEMENT SHOPMEN and PRODUCTION ENGINEERS
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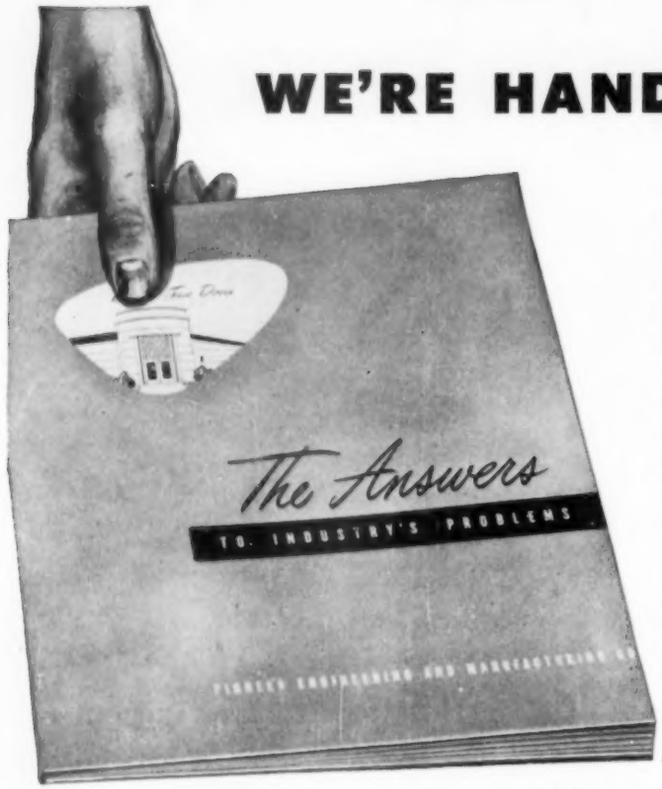

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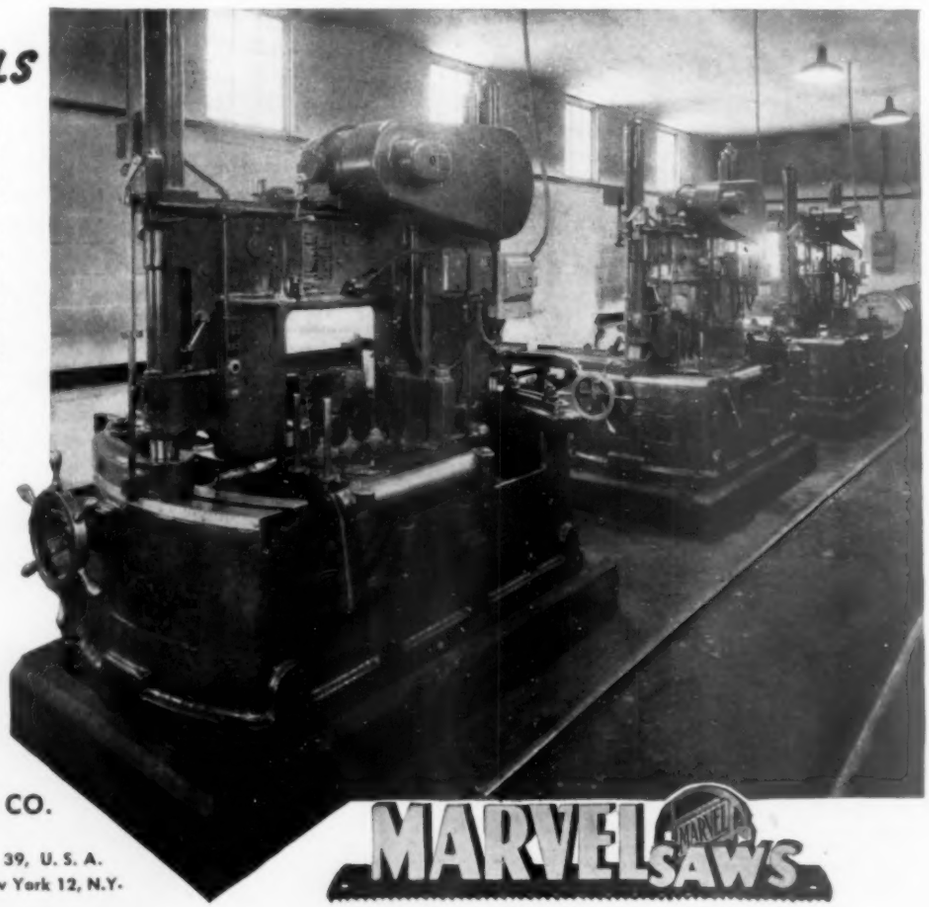

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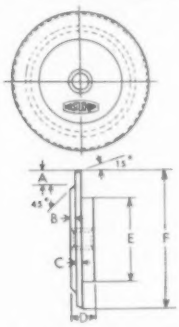
Masterform cut-off tools are made from specially selected high speed steel, carefully hardened and ground to a high polish. Mastercasing, the Masterform process of super-heat-treating, assures more production and 500% LONGER LIFE.



Designed to cut off .005 past center with 1/64 corner break.

ORDER BY CAT. NO.	FOR USE ON MACHINE NO.	STOCK DIA.	A	B	C	D	E	F	PRICE EACH
00-30	00	1/16	.029	1/16	.030	1/4	1 27/64	1.750	4.00
00-40	00	1/8	.0635	1/16	.040	1/4	1 23/64	1.750	4.00
00-50	00	3/16	.0975	1/16	.050	1/4	1 19/64	1.750	4.00
00-60	00	1/4	.131	1/16	.060	1/4	1 19/64	1.750	4.00
00-80	00	3/8	.1985	1/16	.080	1/4	1 15/16	1.750	4.00
0-60	0	3/8	.1935	3/32	.060	5/16	1 5/8	2.250	4.50
0-80	0	1/2	.261	3/32	.080	5/16	1 5/8	2.250	4.50
0-90	0	5/8	.3265	3/32	.090	5/16	1 5/8	2.250	4.50
2-60	2	3/8	.1935	1/8	.060	3/8	2 7/32	3.000	5.60
2-90	2	5/8	.3265	1/8	.090	3/8	2 7/32	3.000	5.60
2-125	2	1	.5234	3/32	.125	3/8	1 29/32	3.000	5.60
2-156	2	1	.5318	3/32	.156	3/8	1 29/32	3.000	5.60

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FOR BOTH STOCK SIZES AND *Special* TO ORDER CUTTING TOOLS

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FOR FORMING AND CUTTING-OFF TOOL USE

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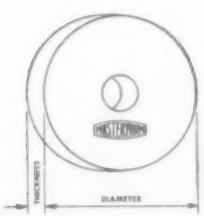
When ordering, please specify whether hard or soft blanks are desired, also diameter or machine number and thickness. Carried in stock for prompt shipment.



Tool blanks for other makes of screw machines can be furnished on special order.

FOR MACHINE NUMBER	DIA. INCHES	THICKNESS INCHES	NET PRICES SOFT BLANKS 1-6	SOFT BLANKS 7-12	HARD BLANKS 1-6	HARD BLANKS 7-12
00,00G,19 AUTO	1 3/4	1/4 to 3/8 by 16ths	1.15	1.10	1.45	1.41
00,00G,19 AUTO	1 3/4	7/16 to 5/8 by 16ths	1.35	1.30	1.71	1.65
00,00G,19 AUTO	1 3/4	11/16 to 7/8 by 16ths	1.75	1.70	2.20	2.15
00,00G,19 AUTO	1 3/4	15/16 to 1 by 16ths	1.80	1.75	2.25	2.20
0 and 0G AUTO	2 1/4	1/4 to 3/8 by 16ths	1.30	1.25	1.67	1.61
0 and 0G AUTO	2 1/4	7/16 to 5/8 by 16ths	1.75	1.70	2.22	2.15
0 and 0G AUTO	2 1/4	11/16 to 7/8 by 16ths	2.15	2.10	2.75	2.68
0 and 0G AUTO	2 1/4	15/16 to 1 1/8 by 16ths	2.45	2.40	3.18	3.10
2 and 2G AUTO	3	1/4 to 3/8 by 16ths	1.80	1.75	2.24	2.17
2 and 2G AUTO	3	7/16 to 5/8 by 16ths	2.50	2.45	3.14	3.06
2 and 2G AUTO	3	11/16 to 7/8 by 16ths	3.15	3.10	4.00	3.92
2 and 2G AUTO	3	15/16 to 1 1/4 by 16ths	3.65	3.60	4.65	4.57
LARGER AND SPECIAL SIZES FURNISHED ON SPECIAL ORDER UNLESS OTHERWISE SPECIFIED, SOFT BLANKS WILL BE FURNISHED						

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Vertical feed dial graduated to .0001" for extreme accuracy.
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ABRASIVE
ACCURACY BOOSTS PRODUCTION
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SPECIFICATIONS

WORK CAPACITY:
24" long
8" wide
12" high

DRIVE:
3 H. P. motor

TABLE SIZE OVERALL:
59" x 10½".

SPINDLE:
2290 R.P.M. bronze box and ball bearing.

WHEEL SIZE:
Standard 10" wheel. 8" or 12" wheels on order.

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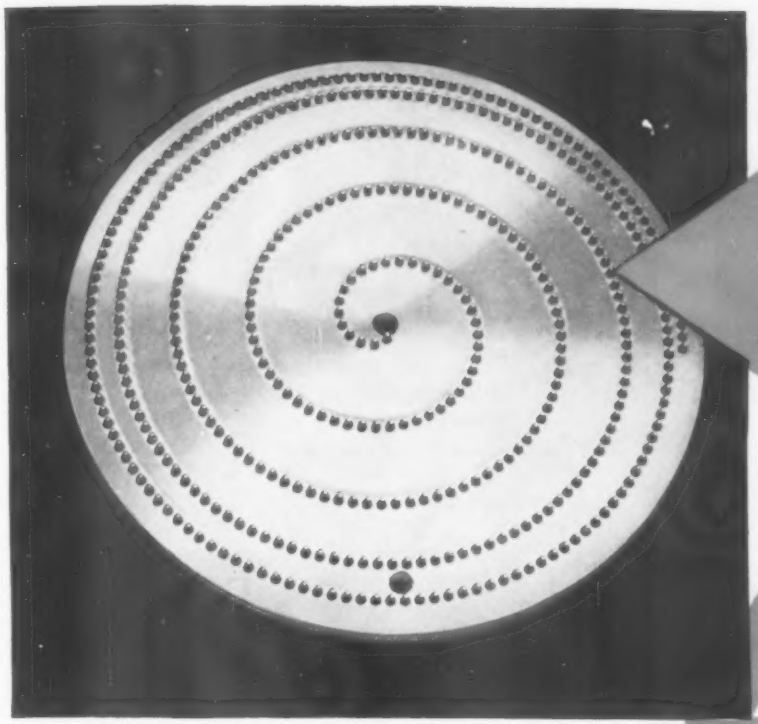

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437 HOLES!

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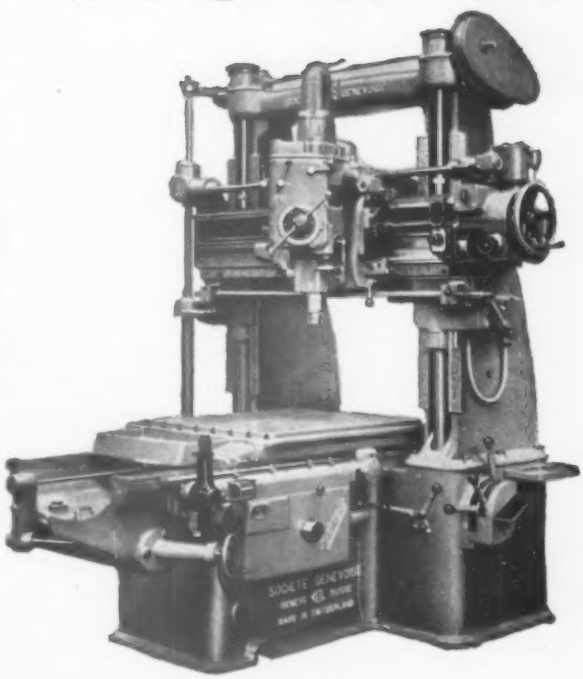

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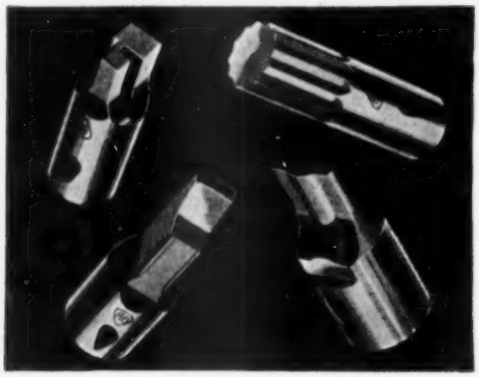

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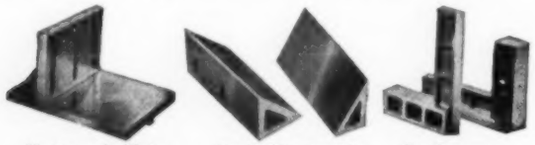

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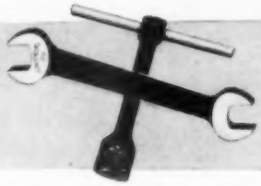

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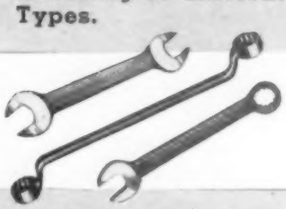

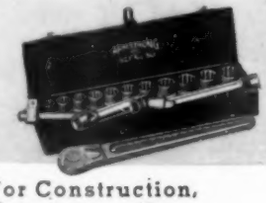

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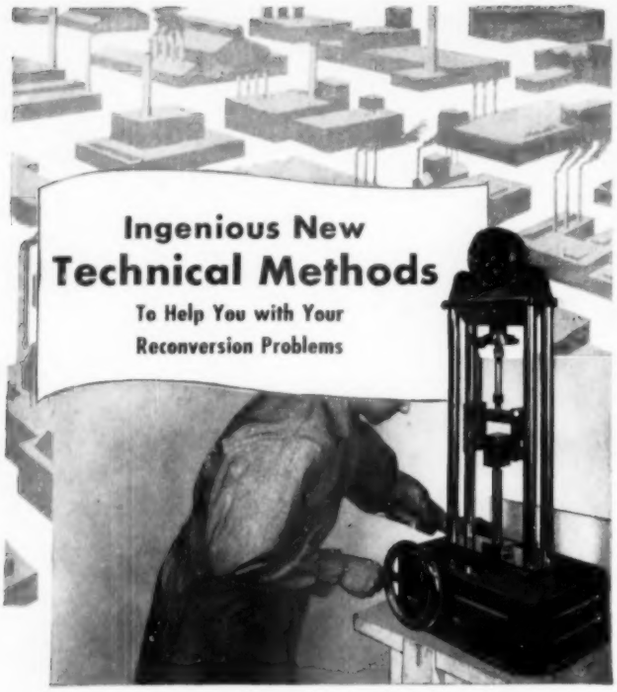

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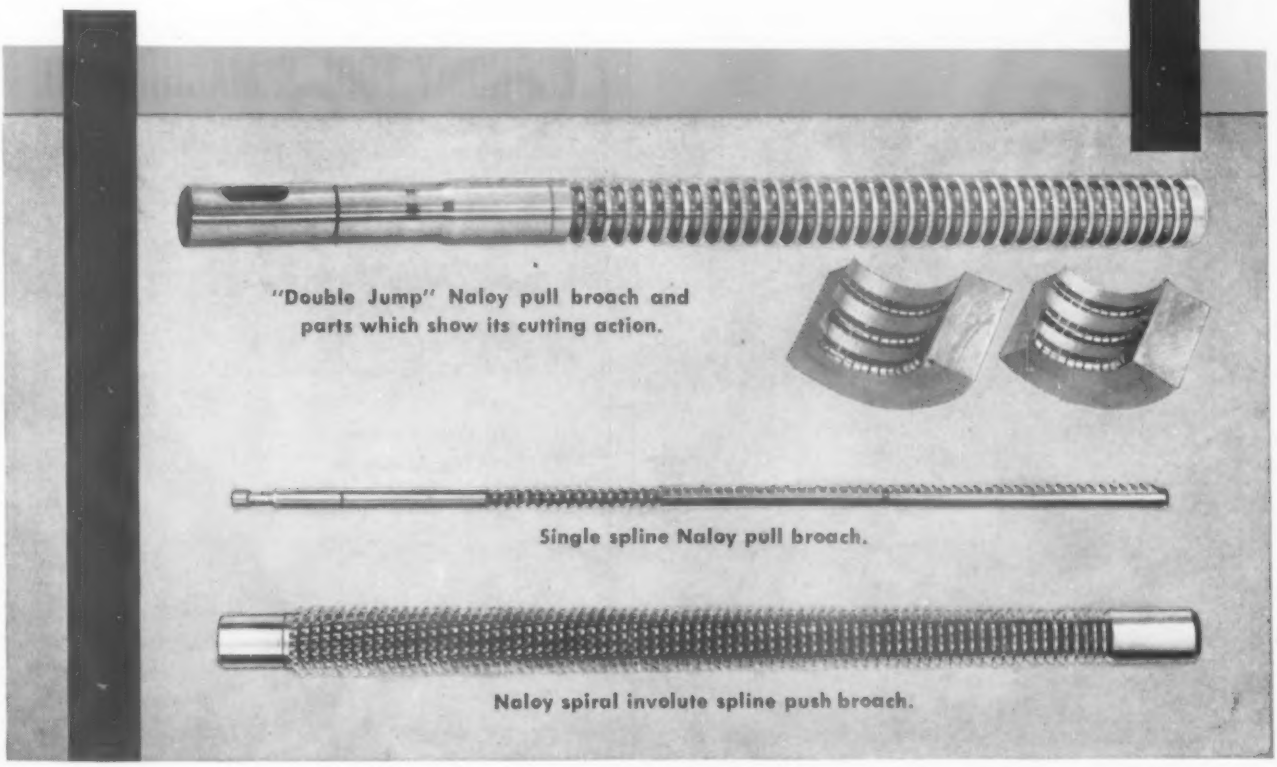

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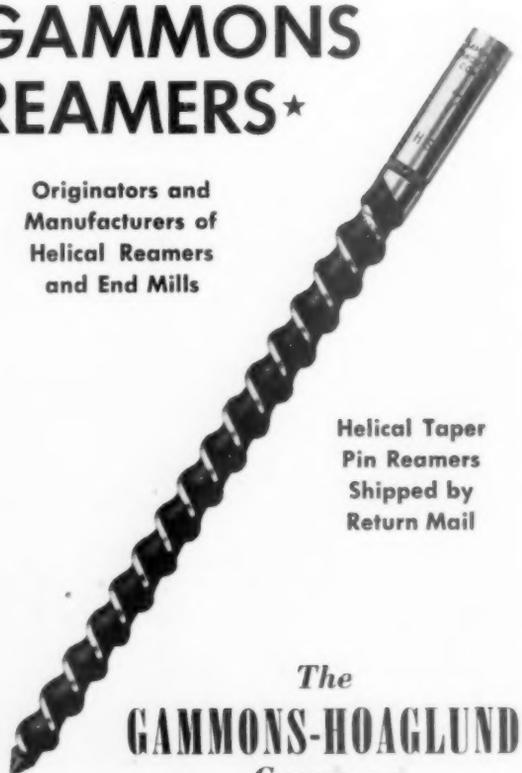

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ON BETTER
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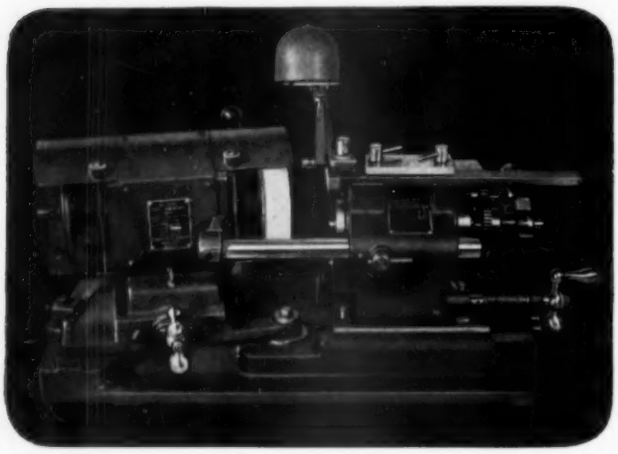

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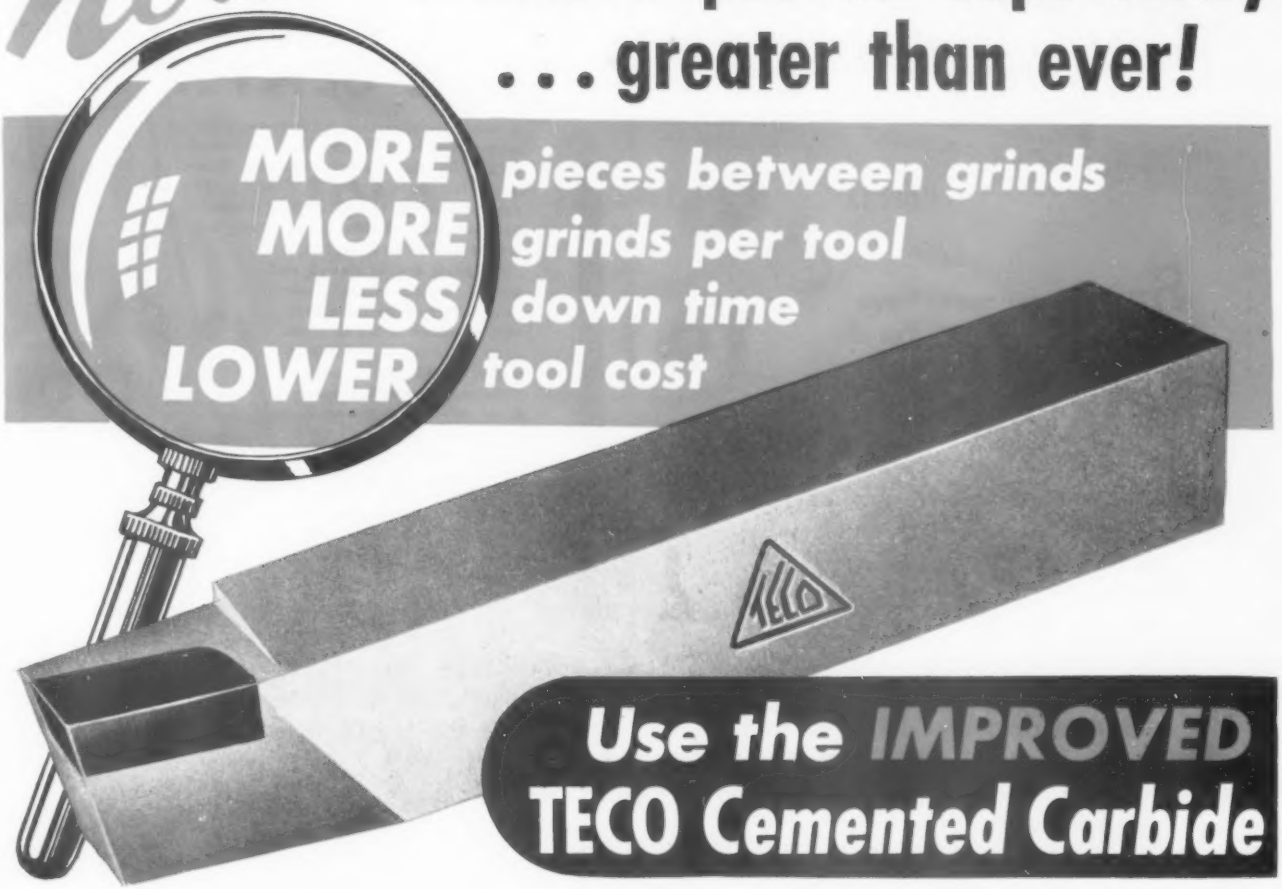

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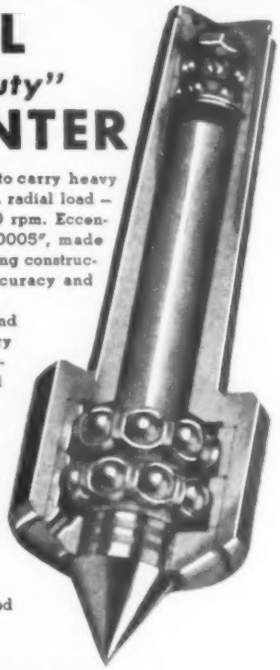

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FONDA *Lifetime-Carbide* COST LESS

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Recent exhaustive accelerated wear-resistance tests on gage blocks made of steel, an alloy of steel, and *Lifetime-Carbide*, in groups of 8 to 16 gage blocks of each material, showed the following average wear: *Lifetime-Carbide*, —11 Millionths; Alloy-of-Steel, —133 Millionths; Steel, —1530 Millionths. These tests, using a common shop abrasive, show conclusively that *Lifetime Carbide* has a life of 12 to 1 over the alloy-of-steel blocks, and 139 to 1 over steel. Since the actual cost of a gage block is determined by its length of *accurate* service, here is positive evidence that FONDA *Lifetime-Carbide* Gage Blocks cost less in use than any other gage block manufactured.

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One of the largest machine-tool manufacturers, a FONDA customer, purchased a 35-C set of *Lifetime-Carbide* Gage Blocks and used this set on the machines in the *grinding room* of their plant. These gage blocks were subjected to extreme punishment; 75 skilled and unskilled men used the blocks on two shifts daily and, according to the customer, in only six months had subjected this set to use that would equal 10 to 15 years of normal gage-block service. At the end of that time, the *Lifetime-Carbide* blocks were inspected, and the forthcoming calibration certificate attested that not one worn gage block could be found! NO WEAR OBSERVED—NOT ONE MILLIONTH! Heretofore, the company had found that their inspection sets of steel gage blocks had worn from 10 to 25 millionths in three months' time, even though handled with meticulous care in their temperature-controlled laboratory.

REMEMBER . . .. THE TRUE TEST OF A GAGE BLOCK IS *HOW LONG IT KEEPS ITS ACCURACY*

Our revised Bulletin 46-1, "Precision in Millionths," includes complete details on both FONDA Steel and Lifetime-Carbide Gage Blocks. Write for your free copy.

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GAGE CO.

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The theory that all gage blocks need a film of oil or moisture to wring properly *is a fallacy* . . . and will lead to error. The addition of *any foreign matter* immediately produces an error equal to the combined thicknesses of the films. FONDA gage blocks, both *Lifetime-Carbide* and steel, with the "ULTRA-FINISH," wring best *absolutely dry and clean*, assuring the accuracy of your measurements.

• ARE GUARANTEED

No other gage-block manufacturer offers a guarantee as extensive and inclusive as FONDA. Write for a detailed copy of the FONDA GUARANTEE.

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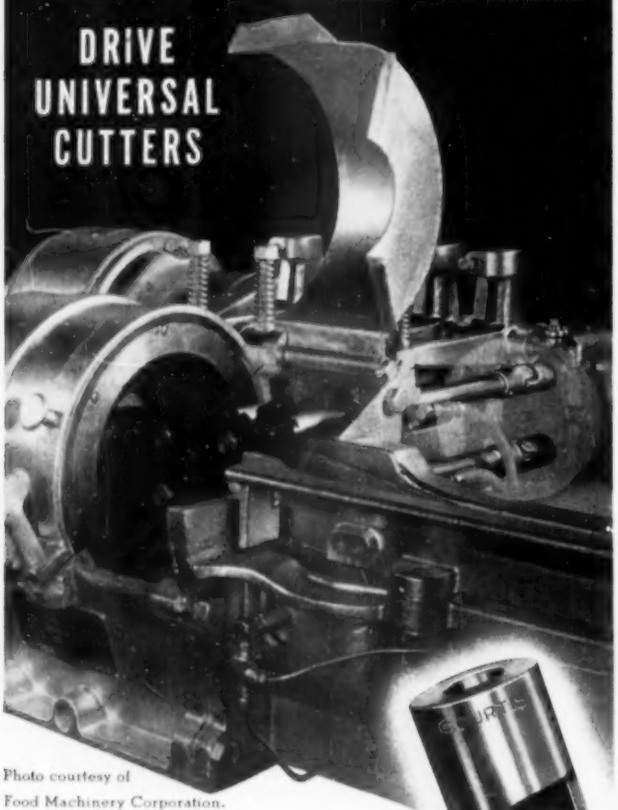
Curtis UNIVERSAL JOINTS...

DRIVE UNIVERSAL CUTTERS



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Ten heavy Curtis Universal Joints drive the feed-roll shafts on this No. 2 Universal Corn Cutter.

Here in the food canning industry — as well as in the machine tool industry — Curtis Universal Joints are selected for their long life, low maintenance and smooth, positive action.

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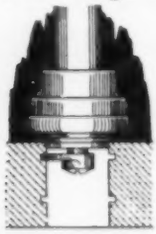
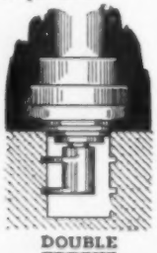


SINGLE GROOVE LOCATED FROM TOP OF HOLE



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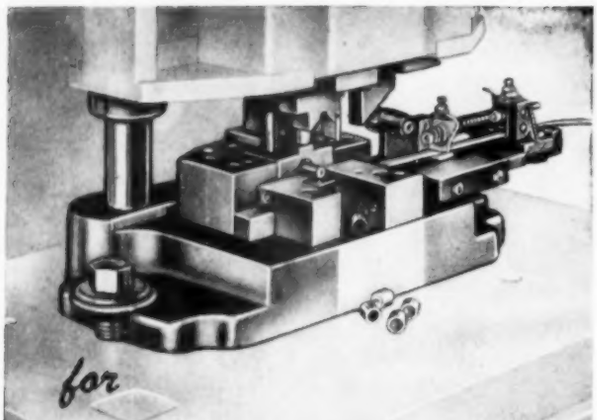

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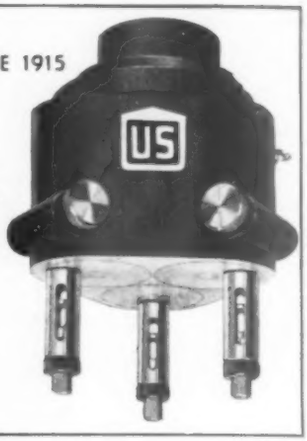

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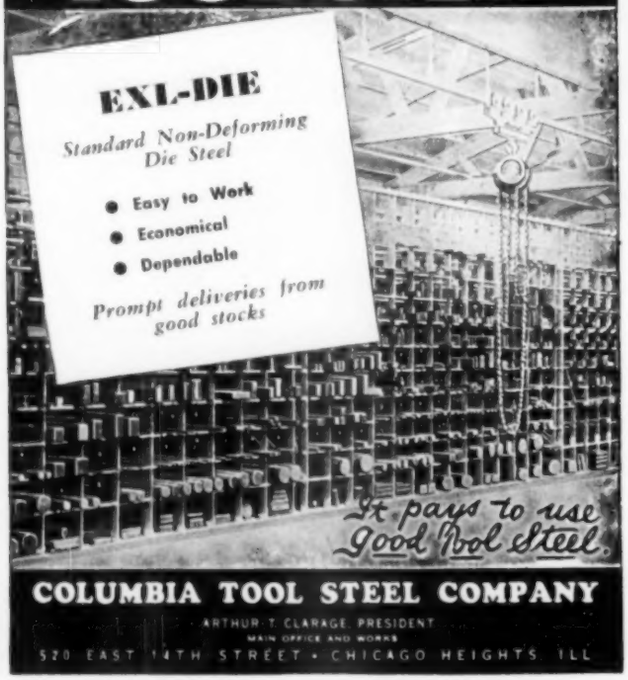

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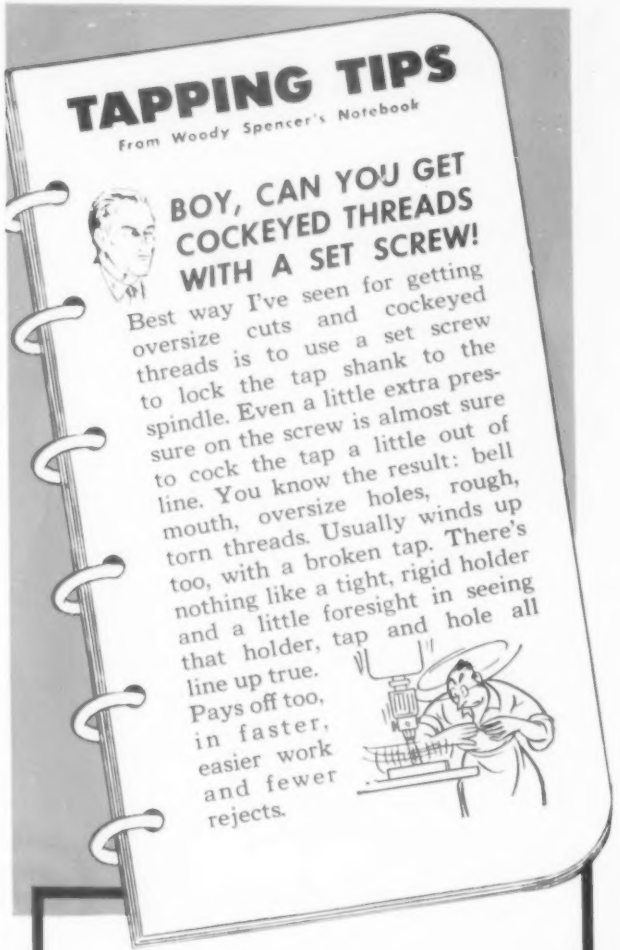
TAPPING TIPS
From Woody Spencer's Notebook
BOY, CAN YOU GET COCKEYED THREADS WITH A SET SCREW!
Best way I've seen for getting oversize cuts and cockeyed threads is to use a set screw to lock the tap shank to the spindle. Even a little extra pressure on the screw is almost sure to cock the tap a little out of line. You know the result: bell mouth, oversize holes, rough, torn threads. Usually winds up too, with a broken tap. There's nothing like a tight, rigid holder and a little foresight in seeing that holder, tap and hole all line up true. Pays off too, in faster, easier work and fewer rejects.

We don't want you to take these Tapping Tips of Woody's as engineering advice designed to solve tapping problems. They are merely handy hints, bits of information and short cuts that the boys in some shop have found out and they are being passed on by Woody for whatever they're worth in saving time, making some routine job run easier, maybe cutting down on rejections.

For the individual problems that come up so frequently, we suggest definite engineering advice. Send us complete data on the job—kind of material, diameter and depth of hole, whether it is blind or through, what kind of lubricant used and any other information regarding the job. Our engineers will be glad to make recommendations covering the job without obligations, of course. *You'll find a copy of Woody Spencer's Handy Tap Guide a mighty useful mine of tap information, all arranged and indexed for quick, easy use. It's FREE. Write for your copy on your company letterhead.*

THE RIGHT TAP AT THE RIGHT TIME

The Wood & Spencer Company
Cleveland 3, Ohio

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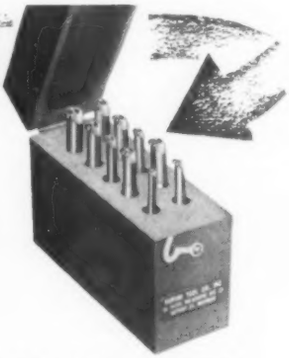

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For internal threading, use Style C

For general boring, use Style A

Ask for catalog N-1139 for high speed steels — catalog N-398 for carbide tipped.

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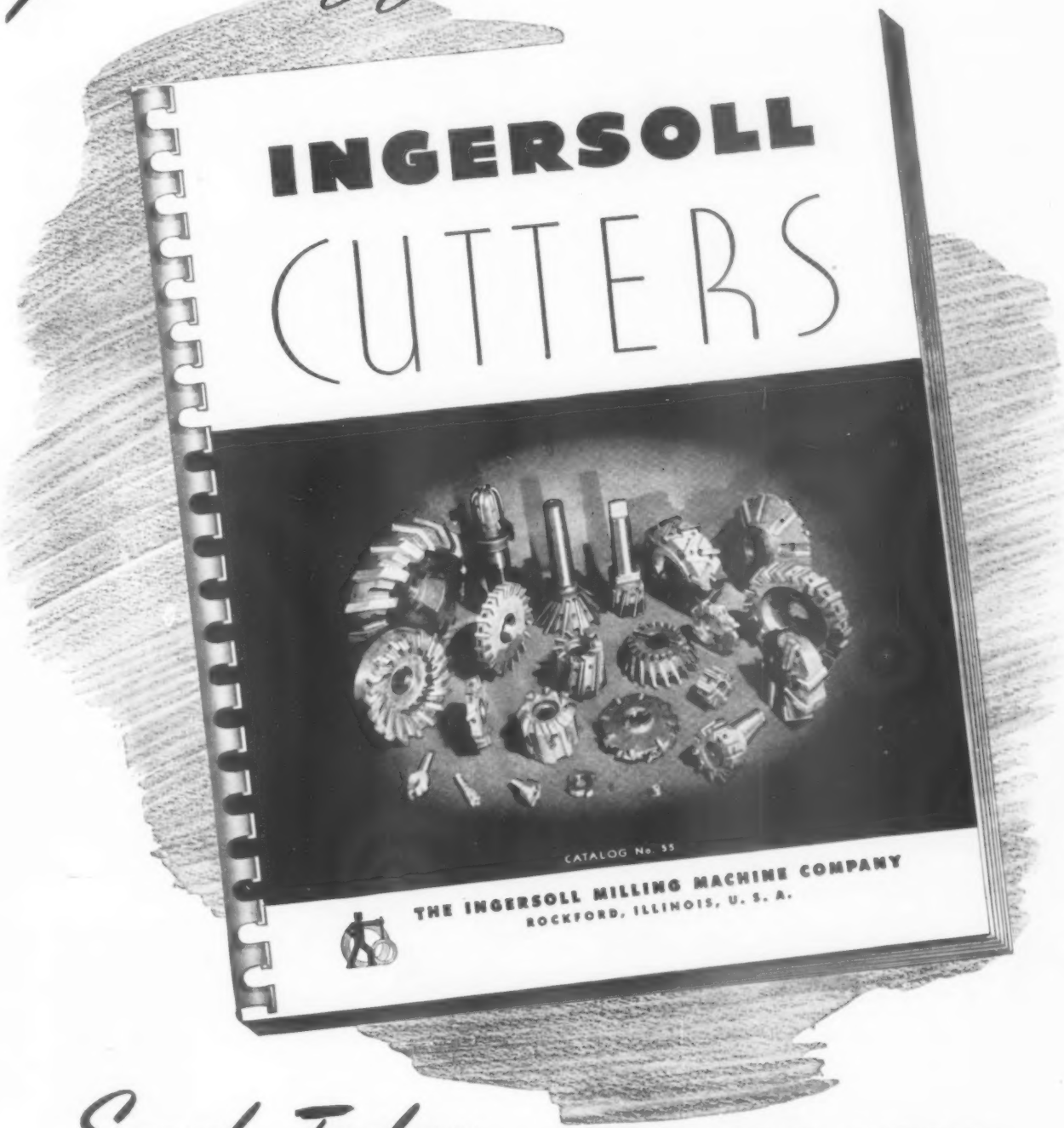

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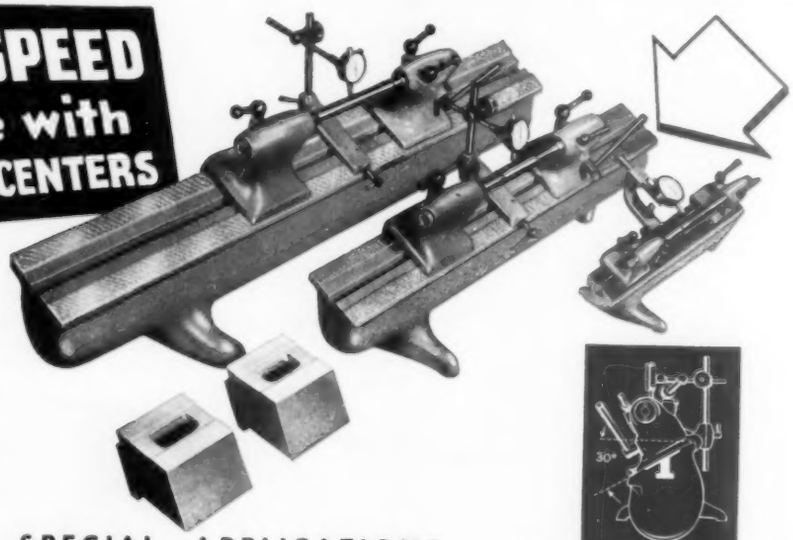

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Sizes: 8" x 36"; 6" x 24"; 4" x 10". Riser blocks may be furnished for use under head and foot stocks to check larger diameters, if desired.

New Catalog 46 gives details. Copy on request.

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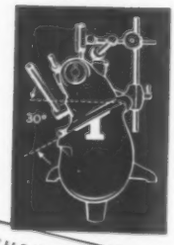
At your service is our Engineering and Designing Department to help you out on any Tooling Program or Special Equipment you may need. Write us about your problem.



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- why they're the only taps that are "i-dot-ified", *red* dot on the shank for cut thread, *white* for commercial ground, *blue* for precision ground
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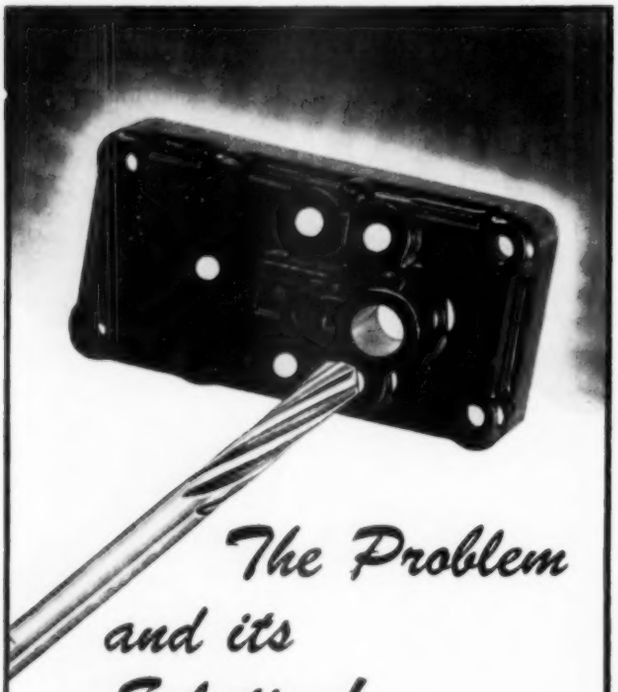

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Wilcolator* had a problem! Plastic casings for its heat controls were breaking at a discouraging rate when ordinary reamers were used to clean and true up the little brass insert moulded into them.

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The same engineering skill that designed and built these special reamers for Wilcolator is exemplified in the regular line of L & I Standards. User after user is daily discovering that the L & I method of grinding after the solid bar is hardened produces a keener, faster-cutting, longer-lived edge, capable of more cuts and greater precision — higher production at lower cost.

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Save Set-up Time IN TAPPING AND REAMING!

Types to fit any machine used for tapping or reaming.

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The Ziegler Floating Holder, because of its floating action, automatically compensates for spindle misalignment of as much as 1/32" off center or 1/16" on the diameter, thus making it possible to entrust set-up work to comparatively inexperienced help without danger of parts spoilage.

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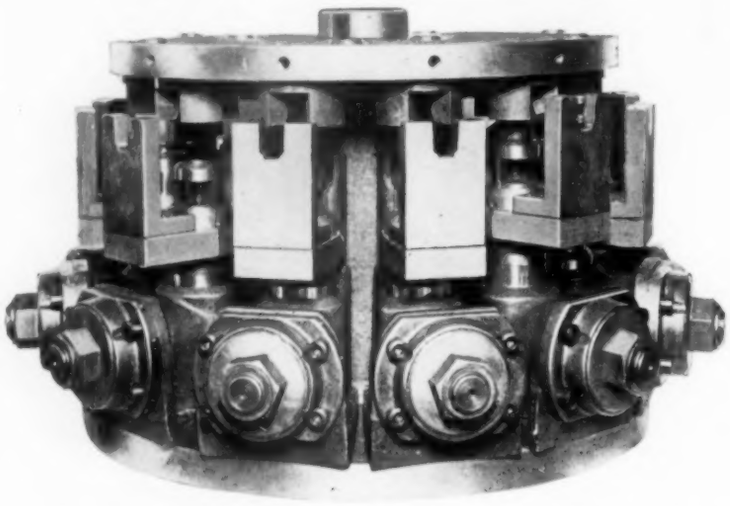

Multiple index fixture to locate and drill hole in boss of brake lever.

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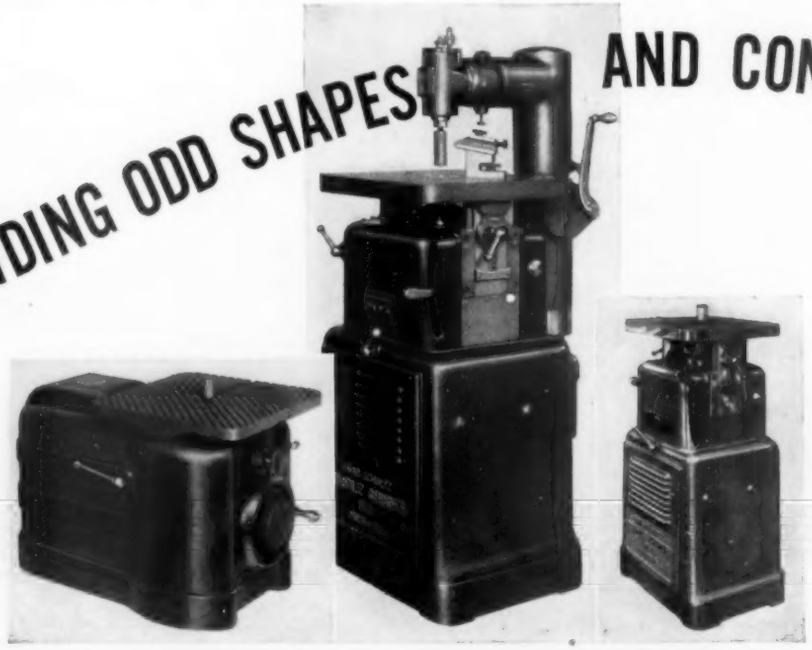

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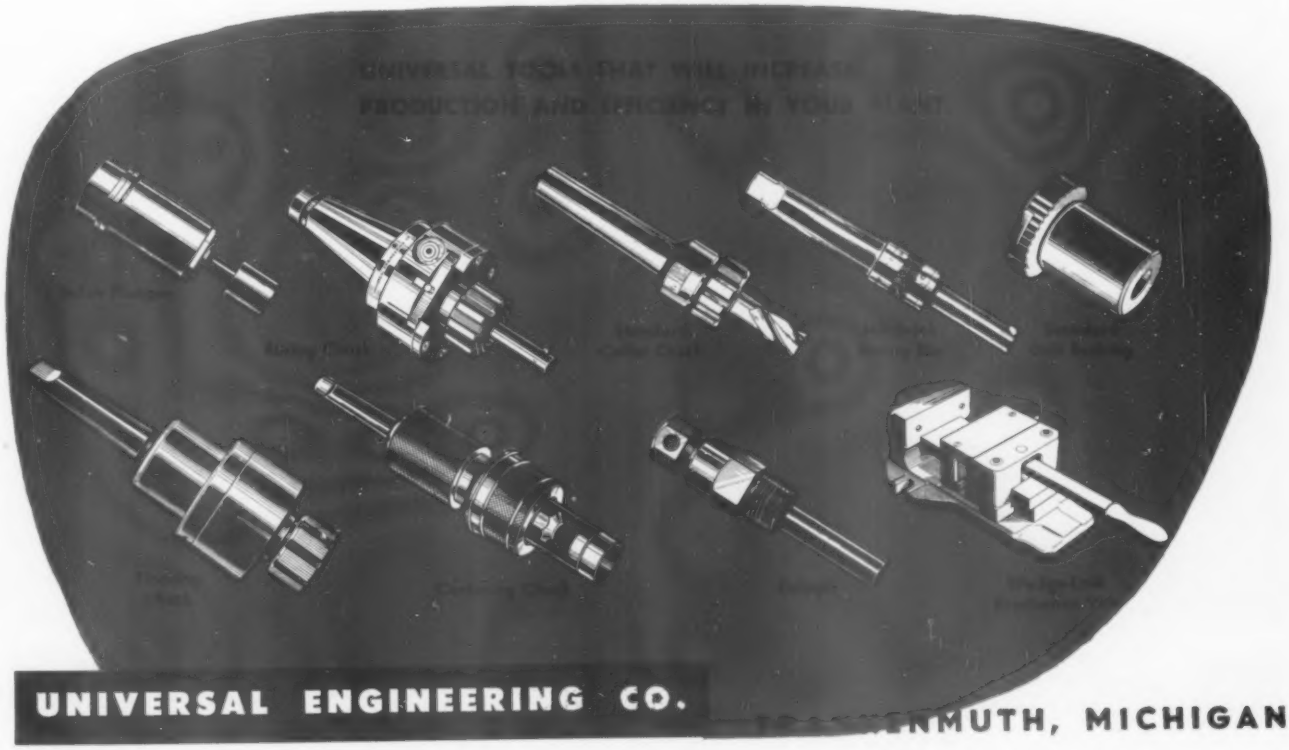

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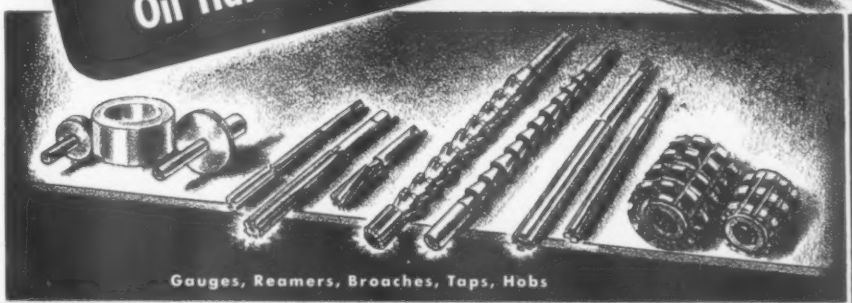
Mn.— 1.20
Cr.— .50
W.— .50
Va.— .20



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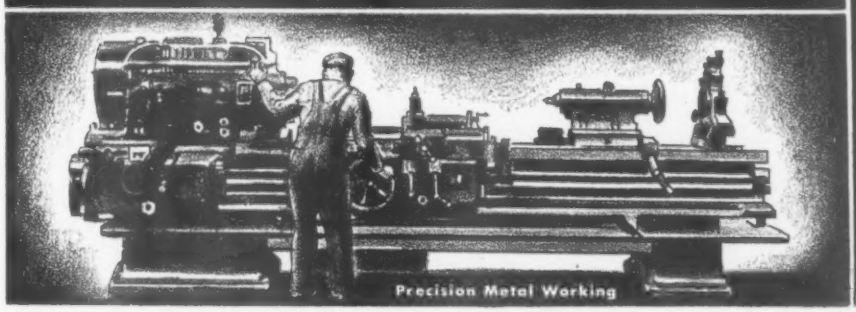

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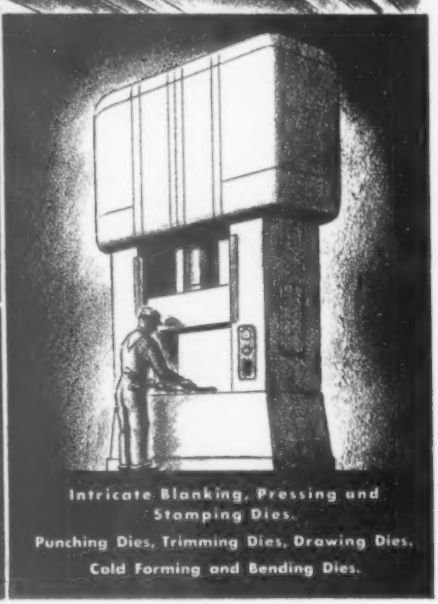

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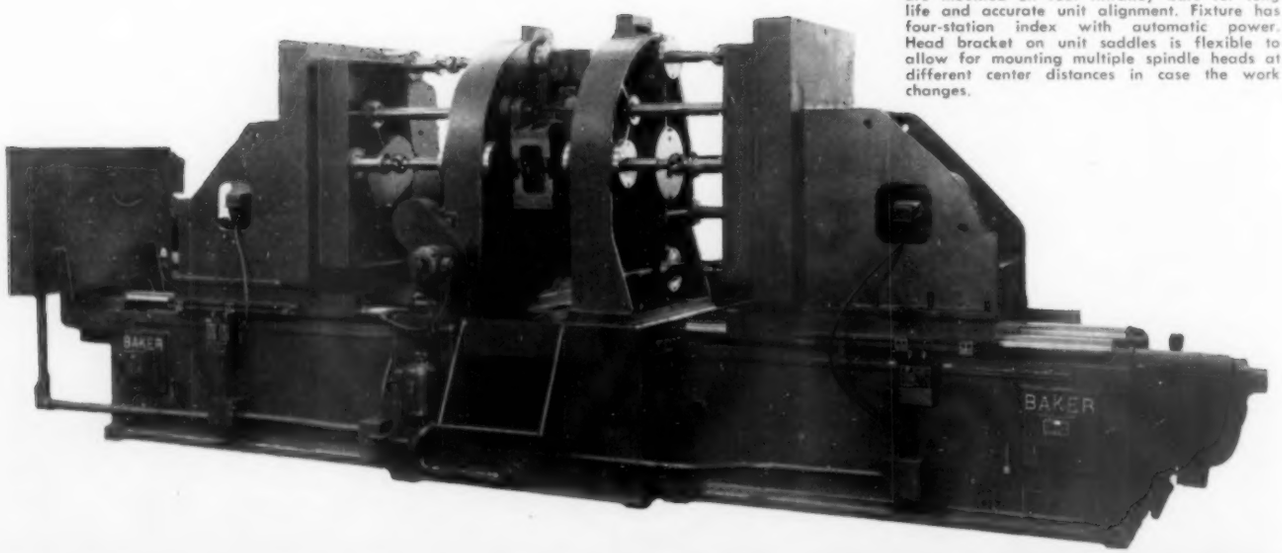
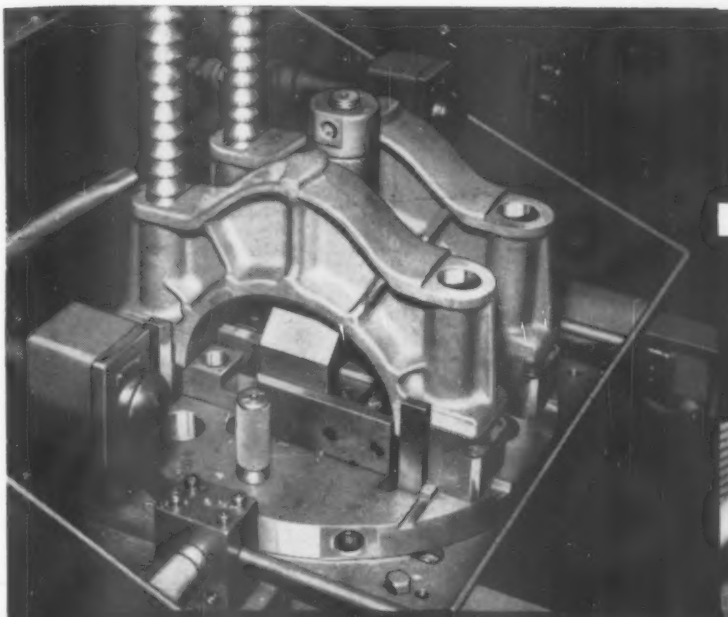


Baker Bros., Inc. TOLEDO 10, OHIO



OILGEAR Finish broaching of four bolt holes (1-9/16" dia.) in two forged steel caps is done in less than a minute by Oilgear Vertical Pulldown Broaching . . . which proved faster and more accurate and eliminated defect-producing scratch marks.

3/16" of stock broached from two bolt bosses simultaneously on Oilgear Vertical Broaching machine which also broaches 1¼" stock from two lock-fit and joint-face surfaces measuring 2¾ x 2¾".

In removing metal and finishing surfaces such as these

. . . Oilgear broaching reduced operations and saved $3872.00 a month

How much can Oilgear Save for YOU?

The parts pictured in the two photographs shown above are main bearing cap forgings used in a well-known Diesel engine. Formerly, these forgings had to be milled . . . planed . . . hand-scraped . . . drilled . . . reamed . . . and bored before they were ready for assembly. Now, with Oilgear Broaching, the task is much simpler. Two bolt bosses, two bolt holes, lock-fits and joint-faces are rough and finished broached. That is all.

The consequences are amazing: More than $60 saved in direct costs for each set of bearing caps, an average of $3872 a month; an abrupt production jump; a far lower investment in equipment; lower tool cost per cap; closer machining tolerances for faster, easier assembly; better finish; less maintenance; less part distortion; less floor space; less power consumed. Oilgear Broaching may well do as much for you.

The time has come for every industrial executive again to take costs seriously. The time has come for every industrial executive to investigate Oilgear Fluid Power Broaching for the tremendous impact it can have on costs of every sort. Get the facts *NOW*. THE OILGEAR COMPANY, 1308 W. Bruce St., Milwaukee 4, Wisconsin.

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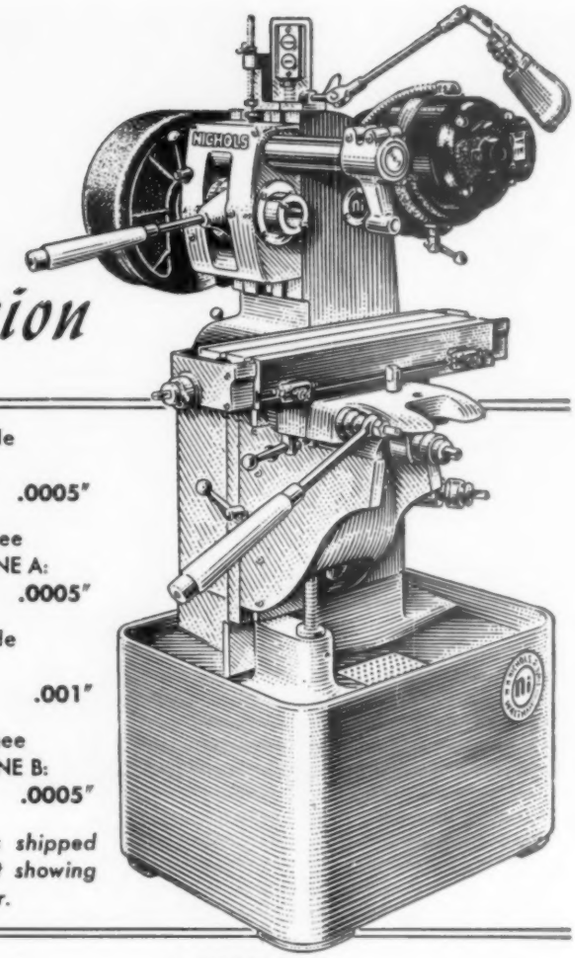
Oilgear manufactures a complete line of broaching machines . . . horizontal and vertical for every internal and external broaching operation. The superiority of Oilgear Broaching Machines results essentially from the recognized superiority of Oilgear Fluid Power. High broaching and return speeds are independently adjustable. Simple push-button controls provide manual, semi-automatic or full automatic operation. Machine, power system and tools are fully protected against overload. Power is consumed in proportion to speed and load only.

Oilgear Fluid Power

Puts the PRECISE *in Precision*



Spindle Taper Runout: Allowable Error	.00015"
Spindle Runout on 8" Mandrel: Allowable Error	.001" F.I.R.
Parallelism of Spindle to Table: With Error at Spindle Nose	.0000"
Allowable Error 8" from Spindle Nose	−.0005"
Parallelism of Spindle to Top of Knee: Allowable Error	.001"
Right Angularity of Table to Spindle on 20" TRAM: Allowable Error	.001"
Squareness of Head Slide to Top of Knee: Allowable Error	.0005"
Parallelism of Head & Knee Slides on Column, PLANE A: Allowable Error	.0005"
Squareness of Head Slide to Top of Saddle: Allowable Error	.001"
Parallelism of Head & Knee Slides on Column, PLANE B: Allowable Error	.0005"

Every Nichols Miller is shipped with an inspection sheet showing these tolerances or better.

Everything about the Nichols Miller has been done to make it as precise as precision can be. Built-in Accuracy . . . Rigidity . . . Speed — all are there ready to give you speed with precision on a single piece or in mass quantity — with Versatility limited only by the imagination of the tool engineer or the capacity of the machine itself.

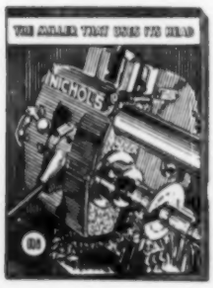
CONDENSED SPECIFICATIONS

Table Working Surface	6¾" x 21" or 30"
Longitudinal Travel (screw or lever)	10" or 19"
Transverse Travel (screw or lever)	7"
Vertical Travel — Knee	13½"
Rise and Fall of Spindle	4½"
Selective Speed Ranges up to 5000 R.P.M.	
Weight	1250 lbs.

✓ RIGIDITY
Carefully designed, uniform-walled, box-type castings take full advantage of cast iron's strength.

✓ VERSATILITY
A "basic" machine easily tooled to handle tool room or production milling within its capacity. Mounting the work in the spindle permits Second Operation boring and facing.

✓ SPEED
For example, the Nichols Miller can turn out 1000 cuts an hour on one setup. Then, after a quick tool change, it can be ready for another job.



Send for your free copy of
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THE *Nichols* MILLER

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NATIONAL DISTRIBUTORS: NICHOLS-MORRIS CORP., 46 CHURCH ST., NEW YORK 7, N.Y.

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Weldments fully stress-relieved

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Exceptionally large engineering and production facilities enable us to deliver the press you need much sooner than many other manufacturers.

Warco presses are the most modern welded steel presses made, offering advantages that experience has shown are most desired by press users. They're engineered specifically for greater rigidity, accuracy, strength, power and endurance.

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Warco open back inclinable presses are especially suited to all light work. Capacity range from 50 to 200 tons, stroke range from four to 14 inches. Single-geared, electrically controlled, with latest type of friction clutch and brake unit.

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Index of Tool Engineer Advertisers

July, 1946

A

Abrasive Machine Tool Co. 108
Hammond-Goff Co.
Acme Industrial Co. 130
Edward C. Kennedy
Acme Tool Co. 112
Diener & Dorskind, Inc.
Allegheny-Ludlum Steel Corp. 101
Walker & Downing
Allen Mfg. Co. 110
Norris L. Bull Advertising
Allied Products Corp. 110
Charles M. Gray & Assoc.
American Gage & Mfg. Co. 130
Ankeney Advertising Agency
Armstrong-Blum Mfg. Co. 106
Roes Llewellyn Advertising
Armstrong Brothers Tool Co. 112
Ross Llewellyn Advertising
Aro Equipment Corp. 93
Beeson-Faller-Reichert, Inc.
Atlas Press Co. 98
Staake & Schoonmaker Co.

B

Baker Brothers, Inc. 138
Bay State Abrasive Products Co. 87
Howard-Wesson Co.
Bay State Tap & Die Co. 116
Hammond-Goff Co.
Charles H. Besly & Co. 90
Evans Associates, Inc.
Bethlehem Steel Co. 84
Jones & Brakeley, Inc.
Edward Blake Co. 118
Henry A. Loudon Advertising
Bokum Tool Co. 128
Charles M. Gray & Assoc.
Boyar-Schultz Corp. 134
C. W. Munger
Brown & Sharpe Mfg. Co. 110
Horton-Noyes Co.
Bryant Chucking Grinder Co. 91
Henry A. Loudon Advertising

C

The Carborundum Co. 10 & 11
Addison Vars Co.
Cleveland Twist Drill Co. 81
Belden & Hickox
Columbia Tool Steel Co. 126
Continental Tool Works Div. of Ex-Cell-O Corp. 143
Holden-Clifford-Flint, Inc.
Cosa Corp. 109
The Cross Co. 6
McLain Organization
Curtis Universal Joint Co. 122
duPont & Cahalin, Inc.
Cushman Chuck Co. 96
Edward W. Robotham & Co.

D

Danly Machine Specialties, Inc. 126
Behel and Waldie and Briggs, Inc.
Darwin & Milner, Inc. 114
Brad-Wright-Smith Advertising, Inc.
Defiance Machine Works, Inc. 89
Beeson-Faller-Reichert, Inc.
Detroit Reamer & Tool Co. 114
Rolfe C. Spinning, Inc.
Detroit Tap & Tool Co. 111
Denham & Co.
H. E. Dickerman Mfg. Co. 126
The DoAll Co. 83
Weston-Barnett, Inc.
The Dumore Co. 105
Behel and Waldie and Briggs, Inc.

E

Economy Tool & Machine Co. 116

F

Fonda Gage Co. 121
The Products Research Co.
Wm. A. Force & Co., Inc. 104
Wendell P. Colton Co.

G

Gairing Tool Co. 15
R. Marshall Advertising
Gallmeyer & Livingston Co. 82
Wesley Aves & Assoc.
The Gammons-Hoaglund Co. 116
Gerotor May Corp. 88
S. A. Levyne Co.
Giddings & Lewis Machine Tool Co. 8 & 9
The Cramer-Krasselt Co.
Gisholt Machine Co. 14 & 79
The Buchen Co.
Grob Brothers 104

H

Hamilton Tool Co. 118
Clinton B. Leap Advertising
Hannifin Mfg. Co. 103
Edwin H. Verrall
Hardinge Brothers, Inc. 3
Taylor Ward, Inc.
R. G. Haskins Co. 123
Robert Emmet Keough Assoc.
The Heald Machine Co. 77
Rickard & Co., Inc.
Henry & Hutchinson, Inc. 80
The Hilliard Corp. 118
Taylor Ward, Inc.
The Holo-Krome Screw Corp. 144
R. H. Young & Assoc.

I

Ideal Industries 120
Van Auken & Ragland
The Ingersoll Milling Machine Co. 129
Cummings-Brand & McPherson

K

Kennametal, Inc. 104
W. S. Hill Co.
Koebel Diamond Tool Co. 126
Holden-Clifford-Flint, Inc.

L

Landis Machine Co. 86
Langsdale Advertising
Lavallee & Ide, Inc. 132
Wm. B. Remington, Inc.
Lyon Machine Co. 124
Franklin Advertising Serv.

M

M-B Products 128
Rolfe C. Spinning, Inc.
Masterform Tool Co. 107
L. H. Gross & Assoc.
James H. Matthews & Co. 128
Cabot & Co., Inc.
Metal Carbides Corp. 100
Meek and Thomas, Inc.
W. F. Meyers Co., Inc. 2
The Caldwell-Baker Co.
The Midvale Co. 94
Lewis & Gilman
Monarch Machine Tool Co. 92
Fuller & Smith & Ross, Inc.

N

National Broach & Machine Co. 115
Witte & Burden
National Tool Salvage Co. 124
Burke Bartlett Co.
Nichols-Morris Corp. 140
Henry A. Loudon Advertising
Norton Co. 78
John W. Odlin Co., Inc.

O

O. K. Machine Co. 124
Willis S. Martin Co.
Oilgear Co. 139
Kirkgasser-Drew
O'Neil-Irwin Mfg. Co. 120
Foulke Agency

P

Park Chemical Co. 113
Marvin Hahn Advertising
Peninsular Steel Co. 137
Brad-Wright-Smith Advertising, Inc.
Perfection Tool & Metal Heat Treating Co. 122
Brandt Advertising Co.
Phoenix Gage Co. 122
Pioneer Engineering & Mfg. Co. 106
St. Claire Advertising Agency
The Potter & Johnston Machine Co. 97
Pratt & Whitney II
Wm. B. Remington, Inc.

Q

Quality Tool & Die Co. 125
Roger Beane Advertising Agency

R

Racine Plating Co. 127
Western Advertising Agency
Ruthman Machinery Co. 132
Bunker & Downing, Inc.

S

Sheffield Corp. III
Witte & Burden
Simonds Saw & Steel Co. 85
Sutherland-Abbott Advertising
South Bend Lathe Works 136
Lamport, Fox, Prell & Dolk, Inc.
Standard Gage Co., Inc. 5
Hevenor Advertising Agency, Inc.
The Staples Tool Co. 117
The Keelor & Stites Co.
The L. S. Starrett Co. 12
Walter B. Snow & Staff, Inc.
Stokerunit Corp. 102
Strong, Carlisle & Hammond Co. 108
Fuller & Smith & Ross, Inc.
D. A. Stuart Oil Co., Ltd. 120
Russell T. Gray, Inc.
Super Tool Co. 16
Wolfe, Jickling, Dow & Conkey, Inc.
Swartz Tool Products Co. 134
Swedish Gage Co. of America 130
Rolfe C. Spinning, Inc.

T

Threadwell Tap & Die Co. 131
Walter B. Snow & Staff, Inc.
Tungsten Electric Corp. 119
Thoma & Gill
Tungtip Tools Div. Lowell & Grayson Mfg. Co. 127

U

United States Drill Head Co. 126
Universal Engineering Co. 135
Seemann & Peters, Inc.

V

Vanadium-Alloys Steel Co. 133
Walker & Downing
Vickers, Inc. 99
Witte & Burden
Vulcan Tool Co. 7
The Chester C. Moreland Co.

W

Walker-Turner Co., Inc. 95
W. L. Towne Advertising
Warren City Mfg. Co. 141
McClure & Wilder, Inc.
S. B. Whistler & Sons 13
Addison Vars Co.
Wilson Mechanical Instrument Co., Inc. 112
Reincke, Meyer & Finn, Inc.
Wood & Spencer Co. 127
Scheel Advertising Agency
N. A. Woodworth Co. IV
Brooke, Smith, French & Dorrance, Inc.
Wm. Wrigley, Jr. Company 114
Ruthrauff & Ryan, Inc.

Z

W. M. Ziegler Tool Co. 132
Rolfe C. Spinning, Inc.

CTW

Continental
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- Boring Bars and Tools
- Broaches
- Broach Pullers
- Broaching Fixtures
- Core Drills
- Counterbores and Countersinks
- CTW Drive Holders
- Counterbores (Tool Room Sets)
- Counterbore Pilots
- Inserted Blade Cutters
- Carbide Tipped Cutters
- Form Relieved Cutters
- Milling Cutters
- Thread Milling Cutters
- End Mills
- Side Mills
- High Speed Steel Reamers
- Carbide Tipped Reamers
- Shell Reamers
- Inverted Spotfacers
- High Speed Steel Tool Bits
- Carbide Tipped Tool Bits
- Circular Form Tools
- Cut-off Tools
- Flat Form Tools
- Dovetail Form Tools

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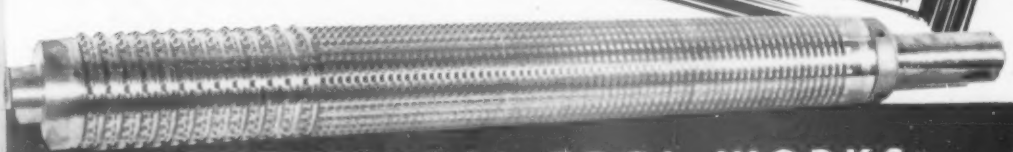
From T.G.
to B.C.
Believe we can combine all three operations on that new part by Broaching ... and save Time and money. How about calling in Continental Tool Works on it?



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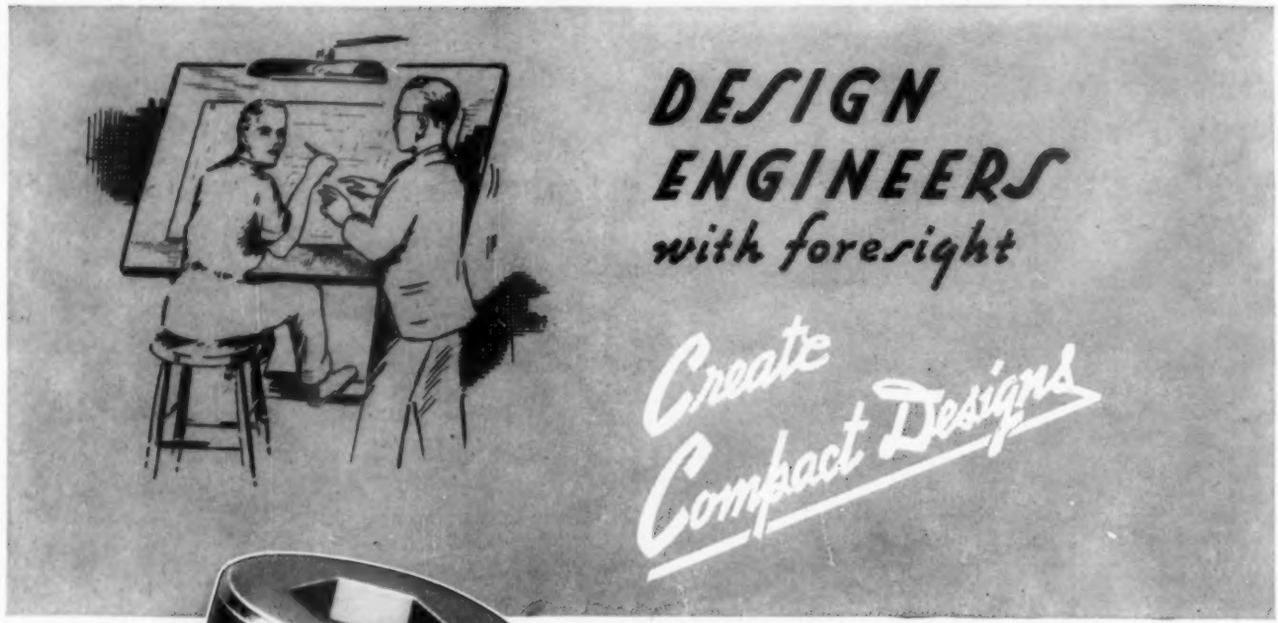

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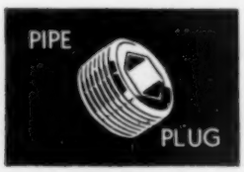

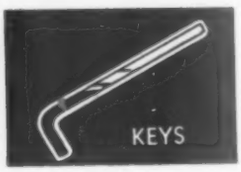

"Measuring at the Machine"

MINIMIZES PRODUCTION LOSSES!

Reducing production LOSSES means reducing production COSTS. LOSSES usually occur at the machine—stopping such losses brings down costs.

"Measuring at the Machine" brings the following advantages which contribute to being able to sell a product profitably at or under competitive prices:

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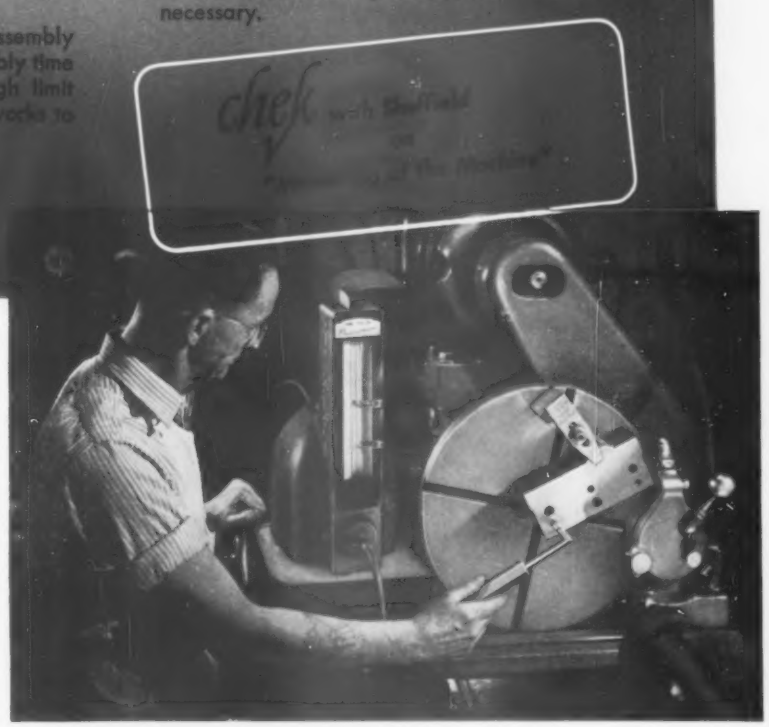
2. "Measuring at the machine" practically eliminates salvage work which is nearly always costly.
3. Component parts reaching the assembly line fit quickly and easily—no assembly time lost. Instead of working to the high limit as an operator normally does, he works to fit the part "on the nose."
4. When high production gaging instruments like the Multichek, Precisionaire and Visual Gage are used at the machine, the floor space devoted to inspection operations, gage maintenance costs and the labor cost of inspection are all greatly reduced.
5. Under close dimensional control, finished products give maximum performance, greater service life, and help build prestige for the manufacturer.
6. Fewer parts will wear out in service, and then replacement is quickly and easily done —no laborious fitting in the field will be necessary.



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